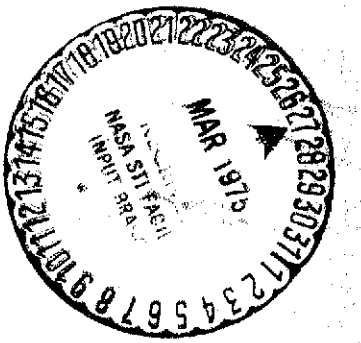
AERONAUTICAL ENGINEERING

A SPECIAL BIBLIOGRAPHY

WITH INDEXES

Supplement 52



JANUARY 1975

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AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 52

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in December 1974 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*

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INTRODUCTION

Under the terms of an interagency agreement with the Federal Aviation Administration this publication has been prepared by the National Aeronautics and Space Administration for the joint use of both agencies and the scientific and technical community concerned with the field of aeronautical engineering. The first issue of this bibliography was published in September 1970 and the first supplement in January 1971. Since that time, monthly supplements have been issued.

This supplement to *Aeronautical Engineering—A Special Bibliography* (NASA SP-7037) lists 175 reports, journal articles, and other documents originally announced in December 1974 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged in two major sections, *IAA Entries* and *STAR Entries*, in that order. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR*, including the original accession numbers from the respective announcement journals. This procedure, which saves time and money, accounts for the slight variation in citation appearances.

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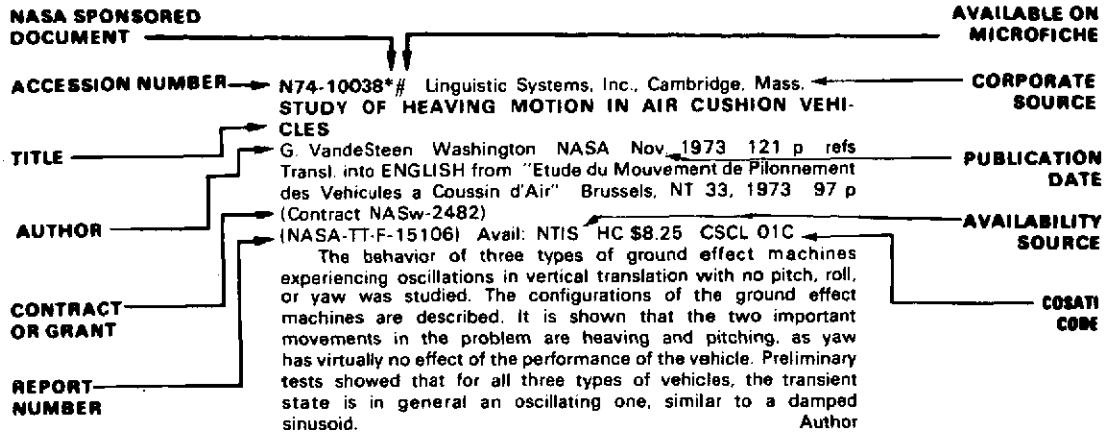

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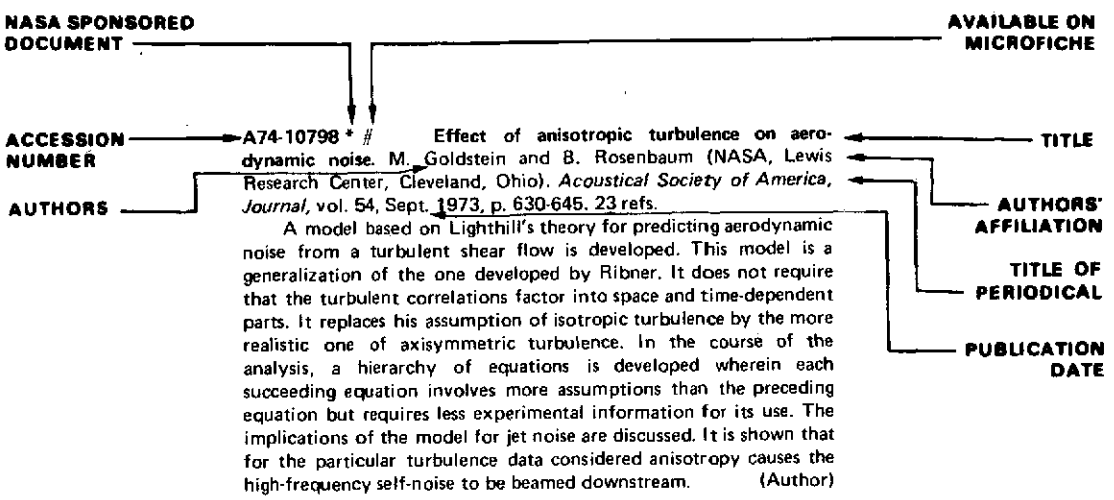

AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 52) JANUARY 1975

IAA ENTRIES

A74-44405 # **Unsteady lift and radiated sound from a wake cutting airfoil.** H. Fujita and L. S. G. Kovasznay (Johns Hopkins University, Baltimore, Md.). *AIAA Journal*, vol. 12, Sept. 1974, p. 1216-1221. 15 refs. Research supported by the United Aircraft Corp.

An experimental study of the transient response of an airfoil to a passing wake, commonly known as 'wake cutting', has been carried out in order to contribute to the basic understanding of interaction between successive blade rows in turbomachinery. An open jet was traversed periodically by moving circular rods in pinwheel fashion and a periodic row of oblique wakes was created. An instrumented airfoil was placed in the jet and microphones were used to obtain the radiated field. By using periodic sampling and averaging technique on all signals, the random, turbulent portion was suppressed, and only the periodic component was extracted. The periodic component of the instantaneous chordwise surface pressure distribution on the airfoil and the radiated sound field from the airfoil were measured and compared with the existing theories. (Author)

A74-44406 * # **Prediction of unsteady airloads for oblique blade-gust interaction in compressible flow.** S. Chu (MIT, Cambridge, Mass.; NASA, Ames Research Center, Moffett Field, Calif.) and S. E. Widnall (MIT, Cambridge, Mass.). *AIAA Journal*, vol. 12, Sept. 1974, p. 1228-1235. 9 refs. Contracts No. DA-31-124-ARO(D)-471; No. N00019-72-C-0450.

The techniques of Galilean-Lorentz transformation and matched asymptotic expansions are used to simplify the procedure of calculating the lift and pressure distribution induced on an infinite-span thin wing interacting with an oblique sinusoidal gust in subsonic flow. This technique requires that the product of the flow Mach number and the reduced frequency be small. Under this condition, the inner region of the transformed space behaves as an incompressible flow, so that existing incompressible flow theories can be used as a basis to construct closed-form solutions for the airload induced on the wing. This approach is an extension of the GASP approximation developed by Amiet and Sears (1970). Results are obtained for both the magnitude and the phase of the unsteady lift due to interaction with gust. These results are compared with available numerical results. Some discrepancies are noted and discussed. (Author)

A74-44417 * # **A quasi-vortex-lattice method in thin wing theory.** C. E. Lan (Kansas, University, Lawrence, Kan.). *Journal of Aircraft*, vol. 11, Sept. 1974, p. 518-527. 16 refs. Grant No. NGR-17-002-107.

A quasi-continuous method is developed for solving thin-wing problems. For the purpose of satisfying the wing boundary conditions, the spanwise vortex distribution is assumed to be stepwise-constant, while the chordwise vortex integral is reduced to a finite sum through a modified trapezoidal rule and the theory of Chebyshev polynomials. Wing-edge and Cauchy singularities are acounted for. The total aerodynamic characteristics are obtained by an appropriate quadrature integration. The two-dimensional results for airfoils without flap deflection reproduce the exact solutions in lift and pitching moment coefficients, the leading edge suction, and the pressure difference at a finite number of points. For a flapped airfoil, the present results are more accurate than those given by the vortex-lattice method. The three-dimensional results also show an improvement over the results of the vortex-lattice method. Extension to nonplanar applications is discussed. (Author)

A74-44418 # **Laminar stall prediction and estimation of the maximum lift coefficient.** S. H. Goradia and V. Lyman (Lockheed-Georgia Co., Marietta, Ga.). *Journal of Aircraft*, vol. 11, Sept. 1974, p. 528-536. 24 refs.

A criterion for the prediction of laminar stall is developed from basic considerations of the laminar boundary layer theory. This criterion is applied to some NACA series two-dimensional airfoil sections and a three-dimensional wing that was wind tunnel tested. The correlation cases are presented for which freestream Mach number was approximately equal to 0.2 and freestream Reynolds number variations were in the range of 1 to 6 million. An estimation of the maximum lift coefficient is made for cases where laminar stall is predicted. This criterion has been found useful both from the point of view of data analysis as well as for the design of a section of a three-dimensional wing for the purpose of delaying the occurrence of laminar stall. In addition, the criterion for the prediction of stall of a two-component airfoil with a leading edge slat is suggested. (Author)

A74-44419 * # **Effect of upper-surface blowing on static longitudinal stability of a swept wing.** P. L. Coe, Jr. and D. Kulla (NASA, Langley Research Center, Joint Institute of Acoustics and Flight Sciences, Hampton, Va.; George Washington, University, Washington, D.C.). *Journal of Aircraft*, vol. 11, Sept. 1974, p. 537-539.

A low-speed wind-tunnel investigation was conducted on a sharp-edged 75 deg delta wing, to determine the effect of upper-surface blowing on static longitudinal stability characteristics. The model incorporated nozzles, located at 0.50 mean aerodynamic chord length, supplied by compressed air to provide blowing on the upper surface. A full span trailing-edge flap was also tested as an additional high-lift device. The angle of attack was varied from 0 to 24 deg for a range of thrust coefficients from 0 to 0.45. The results of the static force tests showed that favorable increments in static longitudinal stability and lift were obtained using upper-surface blowing. (Author)

A74-44420 # **Acoustic backscatter radar system for tracking aircraft trailing vortices.** M. Balser, C. A. McNary, and A. E. Nagy (Xonics, Inc., Van Nuys, Calif.). *Journal of Aircraft*, vol. 11, Sept. 1974, p. 556-562. 7 refs.

The safety hazard posed by potential encounters with invisible vortices from preceding aircraft imposes stringent limitations on aircraft spacing in the terminal area, hence on traffic-handling capacity. An acoustic backscatter radar system has been developed to detect and track such vortices, and thereby to provide the informa-

tion for more advanced air traffic procedures that would eliminate the uncertainty and delay caused by vortices. The system is fully engineered and operates in real time. Examples of the real-time display and of vortex tracks from Boeing 747s landing at the Los Angeles International Airport are given. (Author)

A74-44422 # Attenuation of instabilities in propulsion system combustors. H. T. Couch and L. S. Cohen (United Aircraft Research Laboratories, East Hartford, Conn.). *Journal of Aircraft,* vol. 11, Sept. 1974, p. 571-576. 14 refs.

A theoretical analysis of nonlinear, large-amplitude, acoustic power dissipation by screens and porous liners with and without superimposed uniform flow is presented. Screen and liner acoustic energy dissipation is described in terms of various steady-flow drag coefficients which are appropriate at the large amplitudes and low frequencies characteristic of combustion instabilities in ram burners. The limiting assumption is that particle displacement is large relative to typical screen dimensions. A parallel analysis of acoustic power production attending a large-amplitude, 45-to 50-Hz longitudinal instability in a simulated ramjet combustor. A porous liner which incremented system dissipation by less than 5% was subsequently installed and found to be totally effective in extinguishing the observed instability. (Author)

A74-44424 * # Performance of an inlet for an integrated scramjet concept. C. A. Trexler (NASA, Langley Research Center, Hypersonic Vehicles Div., Hampton, Va.). *Journal of Aircraft,* vol. 11, Sept. 1974, p. 589-591.

Review of the results of an experimental investigation of the performance of an inlet for an integrated scramjet engine concept at Mach 6. Following a description of the inlet design and test model, the Mach 6 experimental results obtained are presented in terms of integrated performance parameters. M.V.E.

A74-44425 # Influence of flaps and engines on aircraft wake vortices. D. C. Burnham and T. E. Sullivan (U.S. Department of Transportation, Transportation Systems Center, Cambridge, Mass.). *Journal of Aircraft,* vol. 11, Sept. 1974, p. 591-592.

Consideration of the nature of aircraft wake vortices and differences in vortex core structure as a function of aircraft type and flap configuration as well as engine location and operation. It is shown that the observed differences are related to engine placement, engine thrust, and wing flap deflection angle for each type of aircraft. M.V.E.

A74-44530 # Minimizing hydrogen pick-up during electroplating of high-strength steels. A. G. Sussex (Australian Defence Scientific Service, Defence Standards Laboratories, Melbourne, Australia). In: Effects of chemical environment on fracture processes; Proceedings of the Third Tewksbury Symposium, Melbourne, Australia, June 4-6, 1974. Melbourne, University of Melbourne, 1974, p. 98-108. 23 refs.

The recent history of the problem hydrogen pickup during electroplating, as solved to date by the aircraft industry, is briefly outlined as a guide to potential users of high- and ultrahigh-strength steels. The cracking of high-strength steel promoted by hydrogen embrittlement is a special case in fracture mechanics and some metallurgical (solid state) and electrochemical (solid-liquid interface) aspects of minimizing embrittlement are discussed. The basis of some preferred techniques is briefly reviewed. (Author)

A74-44538 # Effects of corrodents on the fatigue life of an ultra-high strength steel. J. Y. Mann and D. S. Kemsley (Department of Supply, Aeronautical Research Laboratories, Melbourne, Australia). In: Effects of chemical environment on fracture processes; Proceedings of the Third Tewksbury Symposium, Melbourne, Australia, June 4-6, 1974. Melbourne, University of Melbourne, 1974, p. 207-220. 8 refs.

Notched SAE 4340 steel specimens of UTS 1570 MPa were fatigue-tested to fracture in repeated tension under a four-load-level program-loading sequence in very dry air and in seven 'aggressive' environments - wet air; four processing liquids in either dry or wet air; distilled water; and 3% NaCl solution. Fatigue lives ranged from 53 programs (dry air) to 1 program (wet air plus phosphoric acid). Fractographic examination showed that in some instances crack initiation was unaffected, but crack propagation was rapid, whereas in some other instances the reverse was the case. Fatigue crack propagation rates alone are thus insufficient to predict total fatigue lives. (Author)

A74-44635 The model mounting arrangements in the high speed wind-tunnel testing. M. Ahe and T. Tanioka. *Mitsubishi Juko Giho,* vol. 11, no. 3, 1974, p. 1-5. 10 refs. In Japanese, with abstract in English.

The new strut mounting arrangement on two aircraft force-models was tested along with the conventional sting mounting arrangement in a 60 cm supersonic wind tunnel at the Mitsubishi Nagoya Aircraft Works. The aerodynamic interference effect caused by the model mounting arrangements was investigated and the interference-free data taken from the two different arrangements were compared. The test data show that the strut mounting arrangement is practically applicable to the model configuration aerodynamically unsuitable for the sting mounting arrangement. (Author)

A74-44729 Naval Air Test Center adopts real-time telemetry processing. G. Robertson (Xerox Corp., Rochester, N.Y.). *Signal,* vol. 29, Sept. 1974, p. 29-31. Navy-supported research.

Description of the new real-time telemetry processing system (RTPS) in use at the Naval Air Test Center providing CRT displays and/or strip-chart records and printouts for the performance characteristics of aircraft instrumented with sensors monitoring all the relevant parameters (sometimes in excess of 500), while the monito ed data are transmitted back to the Center. The characteristics checked include a safety, durability, weapons effectiveness, flight qualities, and suitability for carrier use. An outline of the major system elements is presented. M.V.E.

A74-44928 Acoustic-emission detection system. W. Matley, P. Howser, and D. Brock (Surrey, University, Guildford, England). *Non-Destructive Testing,* vol. 7, Oct. 1974, p. 257, 258. Research supported by the Ministry of Defence (Procurement Executive).

Description of a compact, low-cost system for the detection and analysis of acoustic-emission signals over a wide frequency range. With its features of wide bandwidth, amplitude sorting, and rejection of unwanted emissions, the instrument is expected to have various uses in research and industrial applications, such as the monitoring of geological structures and aircraft frames. M.V.E.

A74-44930 # On lifting wings with parabolic tips. P. F. Jordan (Martin Marietta Laboratories, Baltimore, Md.). *Zeitschrift für angewandte Mathematik und Mechanik,* vol. 54, Aug. 1974, p. 463-477. 17 refs. Contract No. F44620-69-C-0096.

A class of unresolved problems of potential theory is posed by the pressure singularities at the tips of lifting wings. The singularity at parabolic tips is determined by solving the problem of the circular wing without camber in compressible flow. This specific problem can be investigated analytically, and a convenient formulation already is available. As an example, the investigation shows that an elliptic lift distribution cannot be produced by a finite downwash on the wing. Rather, a certain (and interesting) tip singularity, which contains logarithmic components, occurs in all technically meaningful pressure distributions. The same singularity occurs at all parabolic tips in subsonic flow. Since the singularity can be split off, numerical solutions (at least, for the circular wing) easily can be calculated to high accuracy and can be presented in very short tables. (Author)

A74-44953 # Pyrotechnic bonkers for structural tests in flight. P. Larue, M. Millet, and G. Piazzoli (ONERA, Châtillon-sous-

Bagneux, Hauts-de-Seine, France). *(La Recherche Aérospatiale,* May-June 1974, p. 137-146.) *ONERA, TP* no. 1389 E, 1974. 14 p. 5 refs. Translation.

A74-44989 **Aerospace sandwich materials. I (Matériaux sandwich aérospatiaux. I).** S. Dzalba-Lyndis (Société Nationale Industrielle Aérospatiale, Paris, France). *Matériaux et Techniques,* vol. 62, Aug.-Sept. 1974, p. 327-337. In French.

Review of the technology, design, and performance characteristics of various sandwich materials, and discussion of their use in aerospace structures. How the need in such structures for light weight, rigidity, soundproofness, thermal performance, acoustic fatigue resistance and various other capabilities and properties is met by sandwich materials is first outlined. The sandwich core varieties then surveyed include hexagonal, square, hexagonal reinforced, flexible, multiwave, cruciform, rectangular, sinusoidal, stiffened square, staggered hexagonal, honeycomb, corrugated, waffle, and solid cores, both single- and multi-layered. The organic and metallic constituents of sandwich materials and the techniques used in their manufacture are shown to range from balsa wood to high-strength refractory metal alloys and from epoxy gluing to chromium or silver brazing, respectively. In conclusion, the mechanical properties of sandwich materials, including their bending, shearing, compressive, tensile, aging, and fatigue behavior, as well as the test techniques concerned are briefly reviewed. M.V.E.

A74-44991 **Adhesive bonding in the aviation industry and in other industrial sectors (Le collage dans l'industrie aéronautique et les autres secteurs industriels).** B. Liard (Société Prochal, Puteaux, Hauts-de-Seine, France). *Matériaux et Techniques,* vol. 62, Aug.-Sept. 1974, p. 347-355. In French.

Review of the techniques, advantages, requirements, and limitations of adhesive bonding, and survey of its useful application range. Following a comparison of various bonding procedures, it is shown that an appropriate selection of bonding technique and adhesive is likely to meet the requirements of many fabrication and assembly operations. Special attention is given to applications in the motor car, transportation, and building industries as well as in civil engineering. M.V.E.

A74-45000 # **Antiwear properties of jet fuels obtained by blending nonalkalized hydrorefined with straight-run components (Protivoiznosnye svoistva reaktivnykh topliv, poluchennykh smesheniem nezashchelochennykh gidroochishchennykh i priamogonnykh komponentov).** B. A. Englin, V. V. Sashevskii, M. D. Khaikin, N. F. Troitskii, E. D. Radchenko, M. V. Khokhlacheva, and I. V. Rozhkov (Vsesoiuznyi Nauchno-Issledovatel'skii Institut po Pererabotke Nefti i Gaza i Poluchenii Iskusstvennogo Zhidkogo Topliva, USSR). *Khimiia i Tekhnologiia Topliv i Masel,* no. 9, 1974, p. 48-51. 8 refs. In Russian.

A74-45003 **Design to cost during the requirements, development and test phases of systems acquisition.** R. R. Shorey and T. H. Ross (U.S. Department of Defense, Office of the Assistant Secretary of Defense /Installations and Logistics/, Washington, D.C.). *Defense Management Journal,* vol. 10, Sept. 1974, p. 18, 23-26.

A74-45032 **Effect of ejector spacing on ejector-jet noise characteristics.** D. Tirumalesa (Rohr Industries, Inc., Chula Vista, Calif.). *Acoustical Society of America, Journal,* vol. 56, Sept. 1974, p. 911-916. 6 refs.

Full-scale tests were carried out on jet engines equipped with an ejector in conjunction with straight conical and eight-lobe daisy nozzles in order to study the effect of ejector spacing on the spectral characteristics and directivity pattern of the noise radiated from the ejector jets. For each ejector configuration, acoustic measurements were carried out on a semicircular arc of 200 ft radius between 30 and 150 degrees to the engine axis. Measurements were made for five engine speeds, the lowest corresponding to approach, and the highest to take-off conditions. One-third-octave band spectra were obtained, and perceived noise levels were deduced from these measurements. From the data obtained, it appeared that the main effect of the ejector was to modify the noise spectrum in the frequency range above 600 Hz. Maximum decrease in perceived noise level was obtained for zero spacing between nozzle exhaust plane and ejector. These effects are to be attributed to the change in the jet flow and, more importantly, to the channeling and other acoustic properties of the ejector. P.T.H.

A74-45039 **Composites - Standards, testing and design; Proceedings of the Conference, Teddington, Middx., England, April 8, 9, 1974.** Conference sponsored by the National Physical Laboratory. Guildford, Surrey, England, IPC Science and Technology Press, Ltd., 1974. 164 p. $27.90.

Recent studies on the analysis, testing, design, and application of various composite materials (reinforced composites, fiber composites, reinforced glass and plastics, reinforced cement and thermoplastics, etc.) are presented. Some of the topics covered include tension-compression experiments on a fiber reinforced composite of Cu-W, prediction of properties for engineering design with composites, applications of advanced composites in aircraft structures, pyrolytic surface treatment of graphite fibers, acoustic emission and fatigue of reinforced plastics, specifications of fiber reinforced cements, time dependence and anisotropy of the stiffness of fiber-plastics composites, and dynamic testing and performance of unidirectional carbon fiber-carbon composites. P.T.H.

A74-45045 **Applications of advanced composites in aircraft structures.** I. C. Taig (British Aircraft Corp., Ltd., Preston, Lancs., England). In: Composites - Standards, testing and design; Proceedings of the Conference, Teddington, Middx., England, April 8, 9, 1974. Guildford, Surrey, England, IPC Science and Technology Press, Ltd., 1974, p. 40-49; Discussion, p. 49, 50. Research supported by the Ministry of Defence (Procurement Executive).

The paper deals with some present and potential applications of high strength and modulus fibrous composites, particularly carbon fiber/resin materials, in aircraft structures. Their justification is considered from the twin viewpoints of economic efficiency and structural integrity. A simplified appraisal is given of the structural efficiency of various structural elements employing carbon/epoxy material, in relation to the efficiency targets set by aircraft economics. In considering integrity, particular attention is given to detail design features such as joints, end fittings, reinforcements and discontinuities which have a most important influence on material characterisation and structural performance. (Author)

A74-45098 **MBB BO 105 - Concept and worldwide use of a modern helicopter. I (MBB BO 105 - Konzept und weltweiter Einsatz eines modernen Hubschraubers. I).** E. Rumpler and H. Frommlet. *Flug Revue/Flugwelt International,* Oct. 1974, p. 33-36. In German.

The history of the development of the helicopter is reviewed, giving attention to a market analysis which was conducted in the early 1960s and showed a commercial demand for a helicopter with the characteristics of the subsequently developed aircraft. Basic novel features shown by the MBB BO 105 are related to the design of the rotor system. The aircraft employs a rotor system without hinges. The rotor system utilizes a titanium alloy to satisfy critical mechanical requirements. The investigations leading to the selection of suitable materials are discussed along with details regarding the propulsion unit and the gears. G.R.

A74-45100 # **Aerodynamic design evolution of the YF-16.** J. K. Buckner, D. B. Benepe, and P. W. Hill (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-935.* 17 p.

Evolution of the YF-16 aerodynamic features began in preliminary studies in 1968, intensified during analytical studies in 1970-71, and was finalized during wind tunnel tests in 1971-72 and detail design in 1972-73. Early design studies set the basic features of two widely different design approaches. The best features of the two separate initial models were combined into one model (parts from both models were actually fitted together) and the resulting configuration refined through several tunnel entries to produce the final aerodynamic design. The resultant configuration is an integrated design incorporating: automatically actuated leading-edge flaps, sharp-leading-edge forebody strakes for controlled vortex lift, relaxed static stability, a single engine, a simple underslung inlet, a blended wing-body cross-section shape, area-ruled area distribution designed to the combat Mach number range, a single vertical tail, and a high-visibility canopy. (Author)

A74-45203 Optimization of lift and propulsion systems by the method of singularities (Optimisation des systèmes portants et propulsifs par la méthode des singularités). L. Malavard (Paris VI, Université, Paris; CNRS, Laboratoire d'Informatique pour la Mécanique et les Sciences de l'Ingénieur, France). In: Computing methods in applied sciences and engineering; Proceedings of the International Symposium, Versailles, France, December 17-21, 1973. Part 1. Berlin and New York, Springer-Verlag, 1974, p. 20-41. 12 refs. In French.

It is shown that the method of singularities with discretized distribution is well adapted for solving an important problem in aero-hydrodynamics: the optimum circulation distribution of active elements in a lift or propulsion system with a prescribed law of motion. The method consists essentially in the resolution of Laplace equations. A theoretical model of the functioning of lift and/or propulsion systems is stated, and the optimum condition which trades a minimum energy loss for a lift or propulsion effect is defined. Certain important aspects of the method of singularities are discussed: the nonuniqueness of the nature of singularities in the creation of a potential, the choice of singularities for better realizing the type of boundary conditions to be imposed, and the particular case of a periodic distribution of singularities. Application of the method is demonstrated for the treatment of cyclical two- and three-dimensional systems: oscillating wings, flapping wings, and rotating wings. P.T.H.

A74-45226 * Three dimensional flows around airfoils with shocks. A. Jameson (New York University, New York, N.Y.). In: Computing methods in applied sciences and engineering; Proceedings of the International Symposium, Versailles, France, December 17-21, 1973. Part 2. Berlin and New York, Springer-Verlag, 1974, p. 185-212. 18 refs. Contract No. AT(11-1)-3077; Grant No. NGR-33-016-167.

The present work describes a mathematical model and numerical scheme for the computer-aided calculation of two- and three-dimensional transonic flow over an isolated yawed wing with oblique shock waves and a trailing vortex sheet. The flow is modeled by the potential equation for irrotational flow which is hyperbolic at supersonic points and elliptic at subsonic points. A coordinate-invariant difference scheme is used in which retarded difference formulas are constructed to conform with the local flow direction. The resulting 'rotated' difference scheme allows complete flexibility in the choice of a coordinate system. Shock waves are located automatically in the form of compression bands spread over a few mesh widths. The scheme has proven to be stable and convergent throughout the transonic range. Calculations have been performed for Mach number up to 1.2 and yaw angles up to 60 deg, the likely operating range of a yawed-wing transport designed to fly at supersonic speeds. Calculations becomes less accurate towards upper end of range, because the difference scheme is first-order accurate in the supersonic range. P.T.H.

A74-45260 Titanium structural brazing. R. E. Key, L. I. Burnett (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.), and S. Inouye (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *(American Welding Society, Annual Meeting, 55th, Houston, Tex., May 6-10, 1974.) Welding Journal, Research Supplement,* vol. 53, Oct. 1974, p. 426-s to 431-s.

A titanium laminate brazing process is discussed which was part of an integrated program to develop designs, evaluate materials, and fabricate and test a full-scale airframe primary component. Process development for joining the beta annealed Ti-6Al-4V laminate made use of the previously developed brazing filler metal, Ag-5Al-0.5Mn. Fabrication methods for retort brazing wide-area (4 x 10 ft) beta laminated assemblies were investigated. Primary areas of investigation included tooling development, surface preparation, layup of details, brazing parameters, and environmental control. Test results indicated that brazed laminates of satisfactory quality could be achieved by close control of tooling and manufacturing variables. (Author)

A74-45261 Brazed titanium fail-safe structures. H. I. McHenry (National Bureau of Standards, Washington, D.C.) and R. E. Key (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.). *(American Welding Society, Annual Meeting, 55th, Houston, Tex., May 6-10, 1974.) Welding Journal, Research Supplement,* vol. 53, Oct. 1974, p. 432-s to 439-s. 15 refs. Contract No. F33615-73-C-3001.

Brazed fail-safe structures were designed and evaluated for use in aircraft structures. The principal materials of construction were beta annealed 6Al-4V titanium plate and Ag-5.0Al-0.5Mn brazing filler metal. Four design configurations were evaluated for use as the tension cover of a wing carrythrough structure of a variable-sweep aircraft: a brazed honeycomb panel, a frame and panel assembly, a multiple plank design and a three-layer crack arrest configuration. Several component tests were conducted to evaluate the damage tolerance of the three-layer crack arrest configuration. In each test, initial damage such as notches and cracks was locally confined within the structure because of the inability of a crack to propagate from one element to another through a braze line and by the crack arrest capability of brazed stiffeners. (Author)

A74-45269 # The aircraft engine M-14V26 (Aviatsionnyi dvigatel' M-14V26). I. L. Kruchenok and I. V. Keba. Moscow, Izdatel'stvo Transport, 1974. 368 p. In Russian.

The air-cooled four-stroke radial engine described is intended for the Ka-26 twin-engine helicopter. The design and operation of the engine elements and subsystems are discussed, and the theory of the engine is developed. Attention is given to the principles of operation and performance of the low-pressure supercharger. The inflight characteristics of the engine are outlined. Possible engine malfunctions are analyzed, and means of avoiding and eliminating them are noted. V.P.

A74-45307 # Remotely piloted vehicles for the Army. V. Garber (U.S. Army, Office of Chief Scientist, Washington, D.C.). *Astronautics and Aeronautics,* vol. 12, Oct. 1974, p. 46-51.

Early developments concerning remotely piloted vehicles (RPV) during the time from 1956 to 1967 are briefly examined. After a short period of inactivity in this field the investigations concerning the development of RPVs were resumed following a study of the Defense Science Board in 1971. The group conducting the study recommended the development of an RPV for performing surveillance and target-acquisition missions within the range of conventional artillery. Another mission recommended involved the use of a miniature aircraft or slow-burning rocket in a 'Kamikaze' role to attack forward-element point targets of high value. Potential RPV applications were reviewed in the fall of 1973. Details and results of the various RPV-related studies conducted are presented, giving attention to the role of radar, automatic data processing, data links, symbolic displays, and radar cross section reduction. G.R.

A74-45308 # Air Force concepts for RPV application. J. A. Palmer (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). *Astronautics and Aeronautics,* vol. 12, Oct. 1974, p. 52-56.

The RPVs are to complement the manned force and to increase its effectiveness. RPVs can, thus, provide escort jamming of enemy radars in support of a strike penetration. An RPV remotely controlled by a man can be used to conduct an important mission in a highly defended or politically sensitive area. Operational vehicles presently available possess a demonstrated ability to provide low- and high-altitude photo reconnaissance and signal intelligence in high-threat and/or poor-weather conditions. New uses of RPVs being considered include the relay of control signals and an employment as a wide-bank data link for transmitting images from TV or other sensors. High-altitude, long-endurance vehicles could provide continuous surveillance of ocean or land areas. Low-altitude mini-RPV could be used for real-time reconnaissance in a local battle area. G.R.

A74-45309 # **RPV potential for naval applications.** C. V. Bryan and J. H. Pennington (U.S. Naval Weapons Center, China Lake, Calif.). *Astronautics and Aeronautics,* vol. 12, Oct. 1974, p. 58-63.

Prime objectives for the employment of RPVs in naval warfare include tactical reconnaissance, open-ocean surveillance, anti-submarine warfare, strike support, airborne early warning, and command and control. However, some challenging problems remain to be solved before RPVs can play a vital role in sea control and projection of naval forces. A number of the technical and operational risk areas are considered, giving attention to data links, questions of target acquisition and identification, launch and recovery problems, the establishment of a shipboard control station, questions of maintainability and reliability, and aspects of airspace control. G.R.

A74-45366 # **Prediction and measurement of propulsion system performance.** J. Postlewaite and V. Salemann (Boeing Aerospace Co., Seattle, Wash.). *(American Society of Mechanical Engineers, Winter Annual Meeting, Detroit, Mich., Nov. 11-15, 1973, Paper 73-WA/Aero-5.) ASME, Transactions, Series B - Journal of Engineering for Industry,* vol. 96, Aug. 1974, p. 811-819. 10 refs.

The problem of predicting installed propulsion system performance for a specific configuration from isolated inlet, nozzle and airframe data, and from data for similar configurations is discussed. The degree to which element performance may be isolated from measurements made on an integrated propulsion system will be discussed. An approach to evaluation of external performance of inlets and nozzles is presented. The design of parametric tests and some correlations for afterbody pressure drag from such tests are described. Improvement of data quality from model tests with sophisticated simulation of propulsive flows by pretest studies and in-test quality control are proposed. (Author)

A74-45378 * # **Generalized dynamic engine simulation techniques for the digital computer.** J. Sellers and F. Teren (NASA, Lewis Research Center, Cleveland, Ohio). *NATO, AGARD, Propulsion and Energetics Meeting, 44th, Ankara, Turkey, Sept. 9-13, 1974, Paper.* 24 p. 8 refs.

Recently advanced simulation techniques have been developed for the digital computer and used as the basis for development of a generalized dynamic engine simulation computer program, called DYNGEN. This computer program can analyze the steady state and dynamic performance of many kinds of aircraft gas turbine engines. Without changes to the basic program, DYNGEN can analyze one- or two-spool turbofan engines. The user must supply appropriate component performance maps and design-point information. Examples are presented to illustrate the capabilities of DYNGEN in the steady state and dynamic modes of operation. The analytical techniques used in DYNGEN are briefly discussed, and its accuracy is compared with a comparable simulation using the hybrid computer. The impact of DYNGEN and similar all-digital programs on future engine simulation philosophy is also discussed. (Author)

A74-45379 * # **Reynolds number effects on boattail drag of exhaust nozzles from wind tunnel and flight tests.** F. A. Wilcox and R. Chamberlin (NASA, Lewis Research Center, Cleveland, Ohio). *NATO, AGARD, Fluid Dynamics Panel Specialists Meeting on Airframe/Propulsion Interference, Rome, Italy, Sept. 3-6, 1974, Paper.* 26 p. 8 refs.

A family of nacelle-mounted high-angle boattail nozzles was tested to investigate Reynolds number effects on drag. The nozzles were flown on a modified F-106B and mounted on scale models of an F-106 in a wind tunnel. A 19-to-1 range of Reynolds number was covered as a result of the large size differences between models and by flying over a range of altitude. In flight the nozzles were mounted behind J-85 turbojet engines. Jet boundary simulators and a powered turbojet engine simulator were used on the wind tunnel models. Data were taken at Mach numbers of 0.6 and 0.9. Boattail drag was found to be affected by Reynolds number. The effect is a complex relationship dependent upon boundary layer thickness and nozzle boattail shape. As Reynolds number was increased from the lowest values obtained with scale models, boattail drag first increased to a maximum at the lowest flight Reynolds number and then decreased. (Author)

A74-45408 **Problem of the optimal design of gas-turbine engines.** N. D. Kuznetsov. *(Problemy Prochnosti,* vol. 5, Nov. 1973, p. 55-60.) *Strength of Materials,* vol. 5, no. 11, Aug. 1974, p. 1351-1356. Translation.

A74-45410 **An investigation of the degree of damage to gas turbine engine turbine blades after service life.** B. A. Gryaznov, S. S. Gorodetskii, and A. S. Tugarinov (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR). *(Problemy Prochnosti,* vol. 5, Nov. 1973, p. 65-67.) *Strength of Materials,* vol. 5, no. 11, Aug. 1974, p. 1361-1364. 5 refs. Translation.

A74-45427 **Aviation turbine oils - Research objectives and results (Flugturbinenöle - Aufgaben und Ergebnisse der Forschung).** E. Jantzen (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Flugtreib- und Schmierstoffe, Munich, West Germany). *Wehrtechnik,* vol. 12, 1973, p. 462-465. 21 refs. In German. (DFVLR-SONDDR-344)

The objectives of research related to the study of lubrication processes include a determination of the desired lubricant characteristics as a basis for the selection or synthesis of suitable lubricating materials. Connected with this objective is the development of appropriate investigative procedures, analysis methods, and equipment. The results obtained in studies of lubricants for aviation engines are discussed, giving attention to the synthesis of new products, investigations of lubricant stability against oxidation under engine operating conditions, the formation of deposits in aircraft engines, a simulation of lubricant circulation in the engine, analytical tests, oil lubricating characteristics, and the relation between lubricating oil and flight safety. G.R.

A74-45467 # **Evaluation of the friction power in non-isothermal flows of lubricants in clearings of aircraft ball bearings and of their thermal behavior (Otsenka moshchnosti treniia pri neizotermicheskom techenii smazki v zazorakh aviatsionnykh sharikopodshipnikov i ikh teplovogo rezhima).** V. M. Demidovich and A. P. Kliushkin. *Kazanskii Aviatsionnyi Institut, Trudy, Seriia Prikladnaia Mekhanika,* no. 157, 1973, p. 15-21. 7 refs. In Russian.

A74-45472 # **Calculation of wing flutter with allowance for the kinematic constraint between the bending strains in the wing and the aileron deflection (Raschet flattera kryla s uchetom kinematicheskoi sviazi izgibnoi deformatsii kryla i otkloneniia elerona).** B. F. Ivanov and L. K. Sharifullina. *Kazanskii Aviatsionnyi Institut, Trudy, Seriia Prikladnaia Mekhanika,* no. 157, 1973, p. 54-61. In Russian.

A74-45473 # **Calculation of wing flutter with allowance for the kinematic constraint between the total strain and aileron deflection (K raschetu flattera kryla s kinematicheskoi sviaz'iu obshchei deformatsii i otkloneniia elerona).** B. F. Ivanov and V. B. Zhivetin. *Kazanskii Aviatsionnyi Institut, Trudy, Seriia Prikladnaia Mekhanika,* no. 157, 1973, p. 62-67. In Russian.

A74-45544 # **Use of ARTS III in aircraft accident investigation.** C. O. Miller and W. G. Laynor (U.S. Department of Transportation, National Transportation Safety Board, Washington, D.C.). In: What impacts ATC; Proceedings of the Eighteenth Annual Meeting and Technical Program, Miami Beach, Fla., October 15-18, 1973. Washington, D.C., Air Traffic Control Association, Inc., 1974, p. 7-13.

The ARTS III (Automated Radar Terminal System) represents one of the most significant improvements to the ATC system. The ARTS III system provides the accident investigators with a potential source of data regarding an aircraft's flight track. A description is given of the data which are obtainable from the ARTS III and similar equipment, taking into account also the techniques employed to apply such data to an aircraft accident investigation. An example of ARTS III usage in accident cause determinations is discussed. G.R.

A74-45545 # **New radars for ATC.** C. F. Phillips, Jr. (Westinghouse Electric Corp., Aerospace and Electronic Systems Div.). In: What impacts ATC; Proceedings of the Eighteenth Annual Meeting and Technical Program, Miami Beach, Fla., October 15-18, 1973. Washington, D.C., Air Traffic Control Association, Inc., 1974, p. 21-24.

The new radars being developed for the ATC system include the new ARSR-3 en route radar and the ASR-8 terminal radar. Major performance features offered by the new ATC radars are discussed, giving attention to improved antenna systems, sensitivity time control, a high-powered klystron amplifier, enhancements in the transmitted peak power, and advances related to the receiving system of the new radars. Future ATC radar needs and approaches for satisfying these needs are also considered. G.R.

A74-45547 # **Impact of new separation standards.** D. B. Johnson (Allied Pilots Association, Arlington, Tex.). In: What impacts ATC; Proceedings of the Eighteenth Annual Meeting and Technical Program, Miami Beach, Fla., October 15-18, 1973. Washington, D.C., Air Traffic Control Association, Inc., 1974, p. 36, 37.

The significance of new separation standards as seen from a pilot's point of view is considered. It is recommended that a complete evaluation of all factors including future developments should be conducted before a regulatory agency imposes new separation standards. Attention is given to the terminal control area, separation standards for heavy jets, problems of severe weather avoidance, and holding patterns. G.R.

A74-45592 # **Structure of solutions to basic bending and vibration problems for plates of complex shape (Struktura reshenii osnovnykh zadach ob izgibe i kolebaniiakh plastin slozhnoi formy).** L. V. Kurpa, V. L. Rvachev, N. G. Sklepus, and L. A. Uchishvili. In: Theory of shells and plates. Moscow, Izdatel'stvo Nauka, 1973, p. 54-57. In Russian.

A74-45615 # **Optimal parameters of three-layer plates and shells with a honeycomb filler under combined heating and compression (Optimal'nye parametry trekhsloinykh plastin i obolochek s sotovym zapolnitelem pri szhatii i nagreve).** A. Ia. Aleksandrov and M. P. Naumova. In: Theory of shells and plates. Moscow, Izdatel'stvo Nauka, 1973, p. 200-204. 6 refs. In Russian.

A74-45720 **Short-time parameter optimization with flight control application.** F. A. San Filippo (Martin Marietta Aerospace, Orlando, Fla.) and P. Dorato (Colorado, University, Colorado Springs, Colo.). *Automatica,* vol. 10, July 1974, p. 425-430. 7 refs. NSF Grants No. GK-34179; No. GK-33485A1.

A design approach is presented for systems operating over a relatively short period of time about various operating points with state variable constraints. This class of problems is especially relevant to certain flight control problems. The design approach is applied to a simplified model of longitudinal dynamics of the F-4 aircraft operating in three widely separated flight conditions. A linear model is assumed about each operating point. Control is achieved via constrained state feedback. The basic problem is then to minimize a suitable integral quadratic performance measure subject to state variable constraints. The main theoretical result is a theorem which supplies the inequality constraints required to guarantee short-time stability. The short-time optimization problem is ultimately reduced to a nonlinear programming problem with inequality constraints. (Author)

A74-45927 # **Influence of unsteady-state conditions on the magnitude of aerodynamic forces in a cascade (Vliianie nestatsionarnosti na velichinu aerodinamicheskikh sil v reshetke profilei).** V. P. Vakhomchik. *Problemy Prochnosti,* vol. 6, Aug. 1974, p. 14-22. 5 refs. In Russian.

A cascade of thin slightly bent airfoils without a stagger angle, spinning at a constant rate in plane irrotational incompressible inviscid flow at a small angle of attack is examined. The airfoils perform small synchronous vibrations with a constant phase shift at neighboring airfoils. The portions of the unsteady lifting force and moment, generated by trailing vortex systems which form in unsteady flow are analyzed. Analytical quadrature expressions for the unsteady portion of the lifting force and moment are derived, along with asymptotic formulas for the unsteady portion of the lifting force for small and large Strouhal numbers and airfoil spacings under conditions of inphase and antiphase vibrations. V.P.

A74-45928 # **Transient aerodynamic characteristics of thin curvilinear airfoils in cascade (Nestatsionarnye aerodinamicheskie kharakteristiki reshetok tonkikh krivolineinykh profilei).** V. E. Saren (Akademiia Nauk SSSR, Institut Gidrodinamiki, Novosibirsk, USSR). *Problemy Prochnosti,* vol. 6, Aug. 1974, p. 23-28. 6 refs. In Russian.

The transient aerodynamic characteristics are calculated for a range of geometrical cascade parameters and flow conditions characteristic of compressors. It is shown that the curvature of the airfoil profile and the magnitude of the steady load at the airfoils are decisive factors in the calculations. Because of this, calculations based on the model of a lattice of plates vibrating at zero-angle of attack are seen to be of limited applicability. The use of aerodynamic influence coefficients for describing the aerodynamic properties of vibrating airfoils in cascade is shown to be convenient and universal. V.P.

A74-45934 # **Effect of geometric profile and cascade parameters on the critical flutter speed of a compressor blade packet (O vliianii geometricheskikh parametrov profilia i reshetki na kriticheskuiu skorost' flattera paketa kompressornykh lopatok).** N. D. Tikhonov (RKIIGA, Riga, Latvian SSR). *Problemy Prochnosti,* vol. 6, Aug. 1974, p. 57-62. 6 refs. In Russian.

A74-45936 # **Free vibrations of dynamically inhomogeneous airfoil cascades in potential flow (Avtokolebanii dinamicheski neodnorodnykh reshetok profilei v potentsial'nom potoke).** A. N. Fedosova. *Problemy Prochnosti,* vol. 6, Aug. 1974, p. 68-72. 5 refs. In Russian.

The conditions for the excitation of torsional mode shapes of vibration are determined for both dynamically homogeneous and inhomogeneous cascades. Use is made of the transient aerodynamic force coefficients obtained by Saren (1972) for potential incompressible flow through curved airfoils in cascade, and of those obtained by Gorelov (1971) for zero-incidence compressible flow through plane airfoil cascades. The influence of such geometrical cascade parameters as the blade angle, spacing, and blade curvature, and the influence of the Mach number and angle of attack on the critical reduced frequency is demonstrated. V.P.

A74-46071 Integral equation solutions for simply supported polygonal plates. M. Maiti and S. K. Chakrabarty (Indian Institute of Technology, Kharagpur, India). *International Journal of Engineering Science*, vol. 12, Oct. 1974, p. 793-806. 19 refs.

Information about the bending characteristics of polygonal plates under uniform transverse loading is of great importance in the design of swept wings and skew bridges. Approaches for an analysis of the plate bending stresses are examined. An integral equation method for solving biharmonic problems was suggested by Jaswon et al. (1967). An alternative integration method which avoids certain drawbacks of the procedure of Jaswon et al., is proposed. Solutions are obtained for triangular, rhombic, and hexagonal plates. G.R.

A74-46181 Determination of the aerodynamic characteristics of a complexly shaped body in a free molecular flow with consideration of shadowing effects. V. P. Bass, V. M. Kovtunenko, and V. N. Chepurnoi. *(Kosmicheskie Issledovaniia*, vol. 12, Jan.-Feb. 1974, p. 40-44.) *Cosmic Research*, vol. 12, no. 1, July 1974, p. 34-38. Translation.

A74-46236 University of Toronto Institute for Aerospace Studies, Quarter Century Symposium, Toronto, Canada, April 1, 2, 1974, Proceedings. *Canadian Aeronautics and Space Journal*, vol. 20, May 1974. 92 p.

Progress and future trends in aeronautical and space sciences are evaluated. State-of-the-art wind tunnel testing and the design of aircraft for both high and low subsonic speeds are described. Current research in sonic boom and trace gas analysis, satellite dynamics, and shock tube technology is reviewed. Some additional topics covered include: ejector-powered lift systems for V/STOL aircraft, attitude dynamics of Canadian satellites, a multipurpose trace atmospheric Drustvo, 1973. No. 1, 212 p.; no. 2, 264 p.; no. 3, 152 p.; no. 4, 155 p. In Serbo-Croatian.

Topics discussed include space law terminology, an MHD axisymmetric boundary layer on a body undergoing periodic motion, thermal shock on a simply supported circular plate, countermeasures against weightlessness, pollution of the environment by space activities, an automatic engine control system, aircraft highjacking and related terrorist acts, jet flows near curved walls, an automatic control system for an orbiting observatory, aircraft takeoff from wet runways, blown-flap boundary layer control, the boundary layer in a hypersonic nozzle, nonmanual control of sequences of elementary movements, loading of horizontal tail surfaces, inertial characteristics of flight vehicles, stability of dynamic systems, equilibrium in the weightless state, longitudinal controllability of aircraft, heat transfer from a cylinder in a cross-flow, use of the Magnus effect to increase wing lift, aerodynamic heating of a wire in a supersonic flow, the use of a flight simulator in aircraft accident analysis, constrained torsion of thin-walled structures, and aircraft stability during gusts. A.B.K.

A74-46237 * # Ejector-powered lift systems for V/STOL aircraft. D. C. Whittley (De Havilland Aircraft Company of Canada, Ltd., Downsview, Ontario, Canada). *(University of Toronto Institute for Aerospace Studies, Quarter Century Symposium, Toronto, Canada, Apr. 1, 2, 1974.) Canadian Aeronautics and Space Journal*, vol. 20, May 1974, p. 179-189. 9 refs. Research supported by the Defence Research Board, Department of Industry, Trade and Commerce, De Havilland Aircraft Company of Canada, and NASA.

The paper takes a brief look at powered lift from the point of view of the operator and the designer, considers application of an ejector-powered lift system to both STOL and VTOL aircraft, and describes some of the advantages of an ejector concept. Performance and noise characteristics of a simple ejector are described, and some comments are made regarding the Buffalo/Spey Augmentor-Wing proof-of-concept aircraft. (Author)

A74-46239 # Sonic boom research at UTIAS. J. J. Gottlieb (Toronto, University, Toronto, Canada). *(University of Toronto Institute for Aerospace Studies, Quarter Century Symposium, Toronto, Canada, Apr. 1, 2, 1974.) Canadian Aeronautics and Space Journal*, vol. 20, May 1974, p. 199-222. 33 refs.

The sonic-boom research program recently initiated at UTIAS has already become quite extensive. A summary of research work already completed and in progress has been made. It includes many projects such as prediction techniques of sonic-boom phenomena (corridor width, effects of aircraft maneuvers on focusing of sonic boom, spiked and rounded sonic booms from atmospheric turbulence effects, sonic-boom signature in the shadow zone), the development of sonic-boom simulation facilities (portable simulator, loudspeaker-driven booth, traveling-wave horn), and effects of sonic boom on humans (hearing loss, heart-rate change, automobile-driver behavior), animals (damage to cochleae of mice), and structures (cracking of plaster panels). (Author)

A74-46240 * # Aircraft design for flight below the sonic boom speed limit. R. T. Jones (NASA, Ames Research Center, Moffett Field, Calif.). *(University of Toronto Institute for Aerospace Studies, Quarter Century Symposium, Toronto, Canada, Apr. 1, 2, 1974.) Canadian Aeronautics and Space Journal*, vol. 20, May 1974, p. 225-230. 10 refs.

The avoidance of sonic booms places a constraint on aircraft design and can lead to unusual new configurations. From a comparison among several candidate designs, it is shown that an oblique-wing aircraft offers many advantages when structure, stability, flight efficiency, and airport noise are considered jointly. (Author)

A74-46292 Reliability efforts in large European programs for military and commercial aircraft development. H. Gross (Messerschmitt-Bolkow-Blohm GmbH, Munich, West Germany). *IEEE Transactions on Reliability*, vol. R-23, Aug. 1974, p. 169-173.

A74-46591 # Determination of the critical speed for the flexural-torsional flutter of an airplane wing by a numerical method (Opredelenie kriticheskoi skorosti izgibno-krutil'nogo flattera kryla samoleta chislennym metodom). K. Ia. Kukhta and V. P. Kravchenko. In: Nonlinear boundary-value problems of mathematical physics. Kiev, Izdatel'stvo Instituta Matematiki AN USSR, 1973, p. 326-339. In Russian.

A74-46596 # Unsteady aerodynamic forces induced by the aeroelastic vibrations of a jet engine in a pod (Forces aérodynamiques instationnaires induites par les vibrations aéroélastiques d'un réacteur en nacelle). J.-J. Angélini, S. Chopin, and R. Destuynder (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *La Recherche Aérospatiale*, July-Aug. 1974, p. 209-219. 5 refs. In French.

Theoretical calculations of the unsteady aerodynamic forces induced by the aeroelastic vibrations of a jet engine pod and wind tunnel measurements performed at subsonic flow upon a model provided with an engine pod indicate that jet engine-wing interaction is negligible, but that the unsteady aerodynamic forces induced by

the vibrations of the jet engine itself are of considerable importance for the generation of flutter. In the theoretical discussion, the jet engine in the pod is treated separately and likened to a thin-walled circular cylinder involving internal and external flow. Theoretical and experimental results show satisfactory agreement. M.V.E.

A74-46675 # **Presentation and aerodynamic characteristics of aircraft models derived from an optimal disposition of rectangular biplane wings according to studies of Toussaint, Nenadovic, and Denis (Prikaz i aerodinamicke karakteristike modela aviona izvedenih iz optimalnog odnosa pravougaonih krila biplana prema radovima Toussainta, Nenadovica i Denisa).** D. Dimic (Fabrika Vazduhoplova Utva, Pancevo, Yugoslavia). In: Yugoslav Aerocosmonautics Conference, 1st, Belgrade, Yugoslavia, May 19, 20, 1973, Communications. Number 1. Belgrade, Jugoslovensko Aerokosmonauticko Drustvo, 1973, p. 61-73. 5 refs. In Serbo-Croatian.

Description and comparative analysis of three different biplane types designed by the author. The results of aerodynamic calculations of performances and stability are presented, as well as structural and weight-analysis design solutions and the results of model testing in wind tunnels. Diagrams of the various designs are presented, as well as the measured aerodynamic characteristics, showing that these designs would possess the usual monoplane flight performances. A.B.K.

A74-46685 # **An automatic brake control system for aircraft (Sistem za automatsku regulaciju kocenja tockova aviona).** B. Pavlovic (Industrija Hidraulike i Pneumatike Prva Petoletka, Trstenik, Yugoslavia). In: Yugoslav Aerocosmonautics Conference, 1st, Belgrade, Yugoslavia, May 19, 20, 1973, Communications. Number 1. Belgrade, Jugoslovensko Aerokosmonauticko Drustvo, 1973, p. 177-188. 5 refs. In Serbo-Croatian.

Review of the development, operation, and application of automatic brake control systems on modern aircraft. Following a brief review of the first two generations of aircraft brake control systems, a typical third-generation brake control system is described which contains, in addition to the usual hydraulic installations, electronic and hydraulic components which make possible automatic operation of this system. A.B.K.

A74-46688 # **Fluidics and its application in aircraft and spacecraft (Fluidicka tehnika i njena primena u vazduhoplovnim detilicama i kosmickim brodovima).** M. Sekulic (Beograd, Univerzitet, Belgrade, Yugoslavia) and D. Knezevic (Vazduhoplovnotehnicki Institut, Belgrade, Yugoslavia). In: Yugoslav Aerocosmonautics Conference, 1st, Belgrade, Yugoslavia, May 19, 20, 1973, Communications. Number 1. Belgrade, Jugoslovensko Aerokosmonauticko Drustvo, 1973, p. 207-220. In Serbo-Croatian.

Basic characteristics of fluidic/pneumonic elements and systems are discussed, giving attention to some design details of fluidic vortex rate sensors and gyroscope devices. Fluidic devices are used in attitude stabilization systems for aircraft, missiles, and spacecraft. G.R.

A74-46689 # **Problems of aircraft takeoff from precipitation-covered runways (Problematika poletanja aviona sa poletno-sletnih staza pokrivenih atmosferskim talogom).** E. N. Aleksandrov (Savezna Uprava za Civilnu Vazdusnu Plovidbu, Belgrade, Yugoslavia). In: Yugoslav Aerocosmonautics Conference, 1st, Belgrade, Yugoslavia, May 19, 20, 1973, Communications. Number 2. Belgrade, Jugoslovensko Aerokosmonauticko Drustvo, 1973, p. 1-13. 8 refs. In Serbo-Croatian.

Consideration of three factors which can lead to accidents during aircraft takeoff from precipitation-covered runways. The three factors are precipitation drag at the start of takeoff and a consequent loss of performance, aquaplaning, and spray impingement on the aircraft body and ingestion of spray by the engine. The importance of these problems and the necessity of taking appropriate measures to alleviate them are illustrated by an analysis of the causes of accidents during takeoff and by experience acquired from testing and experimentation. A.B.K.

A74-46691 # **Application of boundary layer control by tangential blowing of a jet over trailing edge flaps (Primena upravljanja granicnog sloja pri tangencijalnom isticanju mlaza duz gornjake zakrilca).** B. J. Cijan (Visa Tehnicka Skola, Belgrade, Yugoslavia). In: Yugoslav Aerocosmonautics Conference, 1st, Belgrade, Yugoslavia, May 19, 20, 1973, Communications. Number 2. Belgrade, Jugoslovensko Aerokosmonauticko Drustvo, 1973, p. 27-45. 14 refs. In Serbo-Croatian.

Consideration of the use of blowing over trailing edge flaps to obtain high maximum lift with a relatively small amount of power. The value of the critical blowing momentum coefficient which prevents flow separation over the trailing edge flaps depends on the jet discharge slot configuration. On the basis of theoretical and experimental studies the takeoff, landing, and climb performances are calculated for a number of blown-flap passenger jet aircraft in the light of current British Civil Airworthiness Requirements. A.B.K.

A74-46695 # **Extremal centering and loading of horizontal tail surfaces (Ekstremne centraze i opterecenje horizontalne repne povrsine).** M. Ilic (Savezna Uprava za Civilnu Vazdusnu Plovidbu, Belgrade, Yugoslavia). In: Yugoslav Aerocosmonautics Conference, 1st, Belgrade, Yugoslavia, May 19, 20, 1973, Communications. Number 2. Belgrade, Jugoslovensko Aerokosmonauticko Drustvo, 1973, p. 89-94. In Serbo-Croatian.

Study of the relation between the extreme permissible center-of-gravity positions of an aircraft and the lift forces on the horizontal tail surface of the surface of the aircraft. The importance of a margin of longitudinal static stability and maneuverability during the startup of the elevator controls in maintaining the lift force of a horizontal tail surface is demonstrated. A.B.K.

A74-46696 # **Idealization and determination of the inertial characteristics of the structure of a flight vehicle (Idealizacija i odredjivanje inercijalnih karakteristika konstrukcije letelica).** S. Lukic and M. Berkovic (Vazduhoplovnotehnicki Institut, Zarkovo, Yugoslavia). In: Yugoslav Aerocosmonautics Conference, 1st, Belgrade, Yugoslavia, May 19, 20, 1973, Communications. Number 2. Belgrade, Jugoslovensko Aerokosmonauticko Drustvo, 1973, p. 95-106. 9 refs. In Serbo-Croatian.

Development of a procedure for determining the mass matrix for an entire flight vehicle within the framework of a program for calculating the aeroelastic properties of the vehicle. Neglecting structural displacements which are expected to be small (and thus also neglecting small inertial forces), a computer computation procedure is developed in which the magnitudes and locations of continuous and concentrated masses are given as the initial data. A.B.K.

A74-46697 # **In-flight symmetrical maneuvers of a flight vehicle (Simetricni manevri letilice u letu).** V. Milenkovic (Vazduhoplovnotehnicki Institut, Zarkovo and Belgrade, Yugoslavia). In: Yugoslav Aerocosmonautics Conference, 1st, Belgrade, Yugoslavia, May 19, 20, 1973, Communications. Number 2.
Belgrade, Jugoslovensko Aerokosmonauticko Drustvo, 1973, p. 107-120. 10 refs. In Serbo-Croatian.

Description of an analytic method of calculating tail loads due to elevator deflection during pitching maneuvers of a flight vehicle. A method of calculating such loads and the acceleration coefficients is proposed for the case where a symmetrical unchecked maneuver with an elevator motion of exponential type occurs as a response of the vehicle to atmospheric turbulence and wind gusts. A.B.K.

A74-46704 # **Study of the polar curve of the G-2 aircraft, and summary of model tests carried out in the T-32 wind tunnel (Ispitivanje polare aviona G-2 u letu i upored jenje rezultata sa dobijenim u aerotunelu T-32 u VTI-u zarkovo).** M. Tesic. In: Yugoslav Aerocosmonautics Conference, 1st, Belgrade, Yugoslavia, May 19, 20, 1973, Communications. Number 2. Belgrade, Jugoslovensko Aerokosmonauticko Drustvo, 1973, p. 183-197. In Serbo-Croatian.

A74-46708 # **Determinant parameters defining the principal layout and design solution of a system for automatic control of the transfer ratio in a longitudinal flight control system (Merodavni parametri za definisanje principijelne seme i konstruktivnog resenja automata regulacije - izmene prenosa u komandnom kolu uzduznog upravljanja).** V. Zeljkovic and S. Zelenkapic (Vazduhoplovnotehnicki Institut, Zarkovo, Yugoslavia). In: Yugoslav Aerocosmonautics Conference, 1st, Belgrade, Yugoslavia, May 19, 20, 1973, Communications. Number 2. Belgrade, Jugoslovensko Aerokosmonauticko Drustvo, 1973, p. 253-260. 15 refs. In Serbo-Croatian.

A74-46709 # **The effect of a program for automatic gear ratio change system operation and stabilizer 'deflection' on the main aerodynamic parameters of the longitudinal controllability of an aircraft (Uticaj programa rada automata za promenu prenosnog odnosa i 'uvoda' stabilizatora na osnovne aerodinamicke parametre uzduzne upravljivosti aviona).** C. Bevc (Vazduhoplovnotehnicki Institut, Zarkovo, Yugoslavia). In: Yugoslav Aerocosmonautics Conference, 1st, Belgrade, Yugoslavia, May 19, 20, 1973, Communications. Number 3. Belgrade, Jugoslovensko Aerokosmonauticko Drustvo, 1973, p. 1-11. In Serbo-Croatian.

Consideration of the role of an automatic gear ratio change system on aircraft with irreversible hydraulic servo devices. Particular attention is paid to the effect of a program of automatic system operation and stabilizer 'deflection' on the main parameters of longitudinal static controllability. The method of calculation and the preparation of data are adapted for operation on digital computers. A.B.K.

A74-46710 # **A contribution to the determination of a short takeoff (Prilog odredjivanju kratkog poletanja).** D. Gajic (Beograd, Univerzitet, Belgrade, Yugoslavia). In: Yugoslav Aerocosmonautics Conference, 1st, Belgrade, Yugoslavia, May 19, 20, 1973, Communications. Number 3. Belgrade, Jugoslovensko Aerokosmonauticko Drustvo, 1973, p. 37-42. In Serbo-Croatian.

Derivation of the equations for determining the takeoff distance of jet aircraft with variable-direction propulsive forces in the case of large T/G ratios. The desired equations are obtained for aircraft with T/G ratios greater than 0.5 from the corresponding system of equations for the motion of an aircraft with constant-direction propulsive forces. A study is then made of the limiting case of a STOL aircraft with a T/G ratio of 1. A.B.K.

A74-46715 # **Use of the Magnus effect for large augmentation of wing lift on modern aircraft during takeoff and landing (Koriscenje efekta Magnusa za znatnije povecanje uzgona krila na savremenim avionima pri poletanju i sletanju).** B. Puharic (Vazduhoplovnotehnicki Institut, Zarkovo, Yugoslavia). In: Yugoslav Aerocosmonautics Conference, 1st, Belgrade, Yugoslavia, May 19, 20, 1973, Communications. Number 3. Belgrade, Jugoslovensko Aerokosmonauticko Drustvo, 1973, p. 107-119. In Serbo-Croatian.

Theoretical and experimental analysis of the Magnus effect in an effort to improve the quality of wing lift during takeoff and landing. A study is made of the effectiveness of combining the Magnus effect with the effect of an airflow over wing flaps induced by a rotating cylinder. An improvement is observed in that flow separation occurs at larger angles of attack (more than 18 deg) and larger flap deflections. A.B.K.

A74-46722 # **Constrained torsion of closed thin-walled structures (Ometeno uvijanje zatvorenih tankozidnih konstrukcija).** J. Novakovic. In: Yugoslav Aerocosmonautics Conference, 1st, Belgrade, Yugoslavia, May 19, 20, 1973, Communications. Number 4. Belgrade, Jugoslovensko Aerokosmonauticko Drustvo, 1973, p. 73-86. In Serbo-Croatian.

Development of an approximate method of determining the normal stresses and additional shear stresses due to constrained torsion of closed thin-walled structures of wing type. It is shown that if a wing is acted on by a torque, in addition to sliding deformation, longitudinal deformations also occur. If the longitudinal deformations prevent wing stiffening, self-balancing normal stresses and corresponding tangential stresses will occur in the wing cross sections. A.B.K.

STAR ENTRIES

N74-33425 Engineering Sciences Data Unit, London (England).
EFFECT OF CUT-OUT ON LIFT-CURVE SLOPE
May 1974 2 p refs
(ESDU-Wings-01.01.04-Amend-A) Copyright. Avail: Issuing Activity

The ratio a sub c/a is plotted against b sub c/b for various values of c sub c/c. The values of a sub c were obtained by using theory for a wing with a rectangular central cut-out, although the values are applicable to a tailplane. The part covered by the body is included in the calculation of the area S, with the leading and trailing edges being continued to the plane of symmetry. The lift-curve slope is influenced only minimally by the interruption of the tailplane if the tailplane is mounted on the body with only a small gap between body and elevator. The effect of the cut-out is negligible. Author

N74-33426*# North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
DEVELOPMENT OF COMPUTER PROGRAMS TO DETERMINE THE AERODYNAMIC CHARACTERISTICS OF COMPLETE LIGHT AIRCRAFT Final Report, 15 Aug. 1972 - 31 Oct. 1974
Frederick O. Smetana Oct. 1974 10 p
(Grant NGR-34-002-179)
(NASA-CR-139690) Avail: NTIS HC $4.00 CSCL 01B

A computer program for determining the flight characteristics of light aircraft was developed. The parameters which were used in the computer program are defined. The accuracy of the system for various types of airfoils is analyzed and the airfoils for which the system does not provide adequate data are identified. The application of a computer program for predicting the fuselage characteristics is discussed. The assumptions and parameters of the fuselage characteristics program are explained. It is stated that the computer programs make it possible to determine the response of a light aircraft to a small disturbance given the geometric and inertial characteristics of the aircraft. Author

N74-33427*# Lockheed-Georgia Co., Marietta.
CALCULATION OF UNSTEADY TRANSONIC AERODYNAMICS FOR OSCILLATING WINGS WITH THICKNESS (COMPUTER PROGRAM)
S. Y. Ruo Sep. 1974 57 p ref
(Contract NAS1-11156)
(NASA-CR-132477) Avail: NTIS HC $3.75 CSCL 01A

A computer program has been developed to account approximately for the effects of finite wing thickness in the transonic potential flow over an oscillating wing of finite span. The program is based on the original sonic-box program of Rodemich and Andrew, and accounts for the nonuniform flow caused by finite thickness by application of the local linearization concept. A brief description of each subroutine is given, and the method of input is shown in detail. A sample problem as well as a complete listing of the computer program are presented. Author

N74-33428# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A MODIFIED THEODORSEN EPSILON-FUNCTION AIRFOIL DESIGN PROCEDURE
Raymond L. Barger Washington Sep. 1974 19 p refs
(NASA-TN-D-7741; L-9578) Avail: NTIS HC $3.00 CSCL 01A

The Theodorsen theory of airfoil design for incompressible flow can be used with the modifications proposed in this paper to design airfoils that satisfy a much wider variety of pressure variations than are permitted by the original Theodorsen procedure. Several examples illustrating this method are computed and discussed. Author

N74-33429*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
IMPROVEMENTS TO THE KERNEL FUNCTION METHOD OF STEADY, SUBSONIC LIFTING SURFACE THEORY
Richard T. Medan Mar. 1974 54 p refs
(NASA-TM-X-62327) Avail: NTIS HC $3.75 CSCL 01A

The application of a kernel function lifting surface method to three dimensional, thin wing theory is discussed. A technique for determining the influence functions is presented. The technique is shown to require fewer quadrature points, while still calculating the influence functions accurately enough to guarantee convergence with an increasing number of spanwise quadrature points. The method also treats control points on the wing leading and trailing edges. The report introduces and employs an aspect of the kernel function method which apparently has never been used before and which significantly enhances the efficiency of the kernel function approach. Author

N74-33430*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LOW-SPEED AERODYNAMIC CHARACTERISTICS OF AIRFOIL SECTIONS WITH ROUNDED TRAILING EDGES IN FORWARD AND REVERSE FLOW
William D. Beasley and Robert J. McGhee Washington Sep. 1974 104 p refs
(NASA-TM-X-3060; L-9327) Avail: NTIS HC $4.50 CSCL 01A

Low-speed wind-tunnel tests were conducted to determine the two-dimensional aerodynamic characteristics of 6-, 12-, and 18-percent-thick airfoil sections with rounded trailing edges in both forward and reverse flow. The shapes incorporated camber with both the leading and trailing edges rounded to provide reasonable aerodynamic performance with either edge directed toward the free-stream flow. The tests were conducted with the airfoils in both normal and reverse orientations relative to the free stream. The Mach number was varied from 0.16 to 0.36 and the angle of attack was varied from minus 10 to 24 million. Reynolds number, based on the airfoil chord, was varied from about 1.0 to 12.0 million. Author

N74-33431*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DEVELOPMENT OF A COMPUTER PROGRAM TO OBTAIN ORDINATES FOR NACA-6 AND 6A-SERIES AIRFOILS
Charles L. Ladson and Cuyler W. Brooks, Jr. Washington Sep. 1974 103 p refs
(NASA-TM-X-3069; L-9558) Avail: NTIS HC $4.50 CSCL 01A

A computer program was developed to produce the ordinates for airfoils of any thickness, thickness distribution, or camber in the NACA 6- and 6A-series. For the 6-series and for all but the leading edge of the 6A-series, agreement between the ordinates obtained from the new program and previously published values is generally within .00005 chord. Near the leading edge of the 6A-series airfoils, differences up to .00035 chord are found. Author

N74-33432*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STABILITY AND CONTROL CHARACTERISTICS AT MACH NUMBERS FROM 0.20 TO 4.63 OF A CRUCIFORM AIR-TO-AIR MISSILE WITH TRIANGULAR CANARD CONTROLS AND A TRAPEZOIDAL WING
Ernald B. Graves and Roger H. Fournier Washington Jul. 1974 235 p

(NASA-TM-X-3070; L-9577) Avail: NTIS HC $6.00 CSCL 16B

Investigations have been conducted in the Langley 8-foot transonic pressure tunnel and the Langley Unitary Plan wind tunnel at Mach numbers from 0.20 to 4.63 to determine the stability and control characteristics of a cruciform air-to-air missile with triangular canard controls and a trapezoidal wing. The results indicate that canards are effective in producing pitching moment throughout most of the test angle-of-attack and Mach number range and that the variations of pitching moment with lift for trim conditions are relatively linear. There is a decrease in canard effectiveness with an increase in angle of attack up to about Mach 2.50 as evidenced by the beginning of coalescence of the pitching-moment curves. At a Mach number above 2.50, there is an increase in effectiveness at moderate to high angles of attack. Simulated launch straps have little effect on the lift and pitch characteristics but do cause an increase in drag, and this increase in drag induces a rolling moment at a zero roll attitude where the straps cause an asymmetric geometric shape. The canards are not suitable devices for roll control and, at some Mach numbers and roll attitudes, are not effective in producing pure yawing moments. Author

N74-33433*# Pennsylvania State Univ., University Park.
THE VORTEX LATTICE METHOD FOR THE ROTOR-VORTEX INTERACTION PROBLEM
Raghuveera Padakannaya Washington NASA Jul. 1974 141 p refs
(Grant NGR-39-009-111)
(NASA-CR-2421) Avail: NTIS HC $4.75 CSCL 01A

The rotor blade-vortex interaction problem and the resulting impulsive airloads which generate undesirable noise levels are discussed. A numerical lifting surface method to predict unsteady aerodynamic forces induced on a finite aspect ratio rectangular wing by a straight, free vortex placed at an arbitrary angle in a subsonic incompressible free stream is developed first. Using a rigid wake assumption, the wake vortices are assumed to move downsteam with the free steam velocity. Unsteady load distributions are obtained which compare favorably with the results of planar lifting surface theory. The vortex lattice method has been extended to a single bladed rotor operating at high advance ratios and encountering a free vortex from a fixed wing upstream of the rotor. The predicted unsteady load distributions on the model rotor blade are generally in agreement with the experimental results. This method has also been extended to full scale rotor flight cases in which vortex induced loads near the tip of a rotor blade were indicated. In both the model and the full scale rotor blade airload calculations a flat planar wake was assumed which is a good approximation at large advance ratios because the downwash is small in comparison to the free stream at large advance ratios. The large fluctuations in the measured airloads near the tip of the rotor blade on the advance side is predicted closely by the vortex lattice method. Author

N74-33434*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FURTHER ANALYSIS OF BROADBAND NOISE MEASUREMENTS FOR A ROTATING BLADE OPERATING WITH AND WITHOUT ITS SHED WAKE BLOWN DOWNSTREAM
James Scheiman Washington Sep. 1974 63 p refs
(NASA-TN-D-7623; L-9349) Avail: NTIS HC $3.75 CSCL 01A

An experimental investigation has been conducted to investigate the broadband noise generated by a rotating-blade system. Tests were made with circular and NACA 0012 rotor-blade sections. The blades were operated only with zero lift at each radial station. Tests were made both with zero axial velocity, so that the blades operated in their own turbulent wake, and with a small axial velocity imposed by the wind tunnel to blow the wake of one blade away before the passage of the next blade. The rotor with cylindrical blades generally radiated more noise throughout the noise spectrum than did the rotor with airfoil blades. Blowing the blade wake away from the rotor with cylindrical blades did not have any appreciable effect on the amplitude frequency spectrum, and the predominant noise was broadband, either with tunnel wind on or off. For the rotor with airfoil blades, however, blowing the blade wake away changed the character of the noise spectrum completely in that broadband noise was eliminated or diminished to such an extent as to be indistinguishable. The broadband noise of the airfoil-bladed rotor with zero axial velocity is apparently caused by lift fluctuations due to velocity components of the turbulence normal to the plane of rotation. Author

N74-33436*# Kansas Univ., Lawrence. Flight Research Lab.
AN ANALYTICAL INVESTIGATION OF WING-JET INTERACTION
C. Edward Lan [1974] 145 p refs
(Grant NGR-17-002-107)
(NASA-CR-138140; CRINC-FRL-74-001) Avail: NTIS HC $10.25 CSCL 01A

The aerodynamic interaction between the wing and an inviscid jet with Mach number nonuniformity is investigated using a two vortex sheet model for the jet. It is shown that one of the vortex sheets accounts for the induced jet flow, and the other, the induced outer flow. Various characteristics of the upper-surface-blowing STOL configuration are also discussed. M.C.F.

N74-33438*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND TUNNEL TEST OF LOW BOOM EQUIVALENT BODY AT MACH 4
Floyd G. Howard and Odell A. Morris Sep. 1974 16 p refs
(NASA-TM-X-72013) Avail: NTIS HC $3.00 CSCL 01A

A body of revolution, representing the equivalent area distribution of a low boom aircraft design cruising at 24,384 meters at a Mach number of 4, was tested to determine whether its theoretical sonic boom characteristics could be experimentally verified. Results indicate that the essential features of the ground signature are well predicted. Author

N74-33440# National Aerospace Lab., Amsterdam (Netherlands).
LOW SPEED WIND TUNNEL MEASUREMENTS ON A TWO-DIMENSIONAL FLAPPED WING MODEL USING TUNNEL WALL BOUNDARY LAYER CONTROL AT THE WING-WALL JUNCTIONS
D. M. deVos 9 Apr. 1973 58 p refs
(NLR-TR-70050-U) Avail: NTIS HC $6.00

An investigation on a two-dimensional wing model with a double-slotted trailing edge flap is described where tunnel wall boundary layer control by blowing was applied to prevent premature flow separations at the junctions between the model and the tunnel walls. From the results it is concluded that tunnel wall boundary layer control at the wall junctions is necessary to obtain useful results from two-dimensional high-lift tests in wind-tunnels. It is shown that a relatively simple system of compressed air blowing slots in the tunnel walls gives a sufficient approximation of the desired two-dimensional flow pattern. The blowing system has already been applied on a routine basis to wing sections with trailing edge and also leading edge high-lift devices. Author (ESRO)

N74-33445*# Systems Technology, Inc., Hawthorne, Calif.
TURBULENCE FLIGHT DIRECTOR ANALYSIS AND PRELIMINARY SIMULATION
Donald E. Johnson and Richard E. Klein Jun. 1974 90 p refs
(Contract NASw-2118)
(NASA-CR-140487; ITR-1003-2) Avail: NTIS HC $7.50 CSCL 01C

A control column and trottle flight director display system is synthesized for use during flight through severe turbulence. The column system is designed to minimize airspeed excursions without overdriving attitude. The throttle system is designed to augment the airspeed regulation and provide an indication of the trim thrust required for any desired flight path angle. Together they form an energy management system to provide harmonious display indications of current aircraft motions and required corrective action, minimize gust upset tendencies, minimize unsafe

aircraft excursions, and maintain satisfactory ride qualities. A preliminary fixed-base piloted simulation verified the analysis and provided a shakedown for a more sophisticated moving-base simulation to be accomplished next. This preliminary simulation utilized a flight scenario concept combining piloting tasks, random turbulence, and discrete gusts to create a high but realistic pilot workload conducive to pilot error and potential upset. The turbulence director (energy management) system significantly reduced pilot workload and minimized unsafe aircraft excursions. Author

N74-33446*# Kanner (Leo) Associates, Redwood City, Calif.
A NEW AVIATION FOR HEAVY TRANSPORT
Jean Bertin Washington NASA Sep. 1974 16 p Transl. into ENGLISH of "Une Nouvelle Aviation de Tranport Lourd" Paris, Aeronaut. Astronaut., no. 46, 1974-3 p 2-8
(Contract NASw-2481)
(NASA-TT-F-15935) Avail: NTIS HC $4.00 CSCL 01C

A study was conducted to determine optimum aerodynamic configurations of aircraft for heavy transport operations. The disadvantages of current passenger aircraft for cargo transportation are explained. The factors considered in the study are: (1) the speed of the aircraft for optimum performance, (2) the dimensions and unit tonnage capability, (3) the use of air cushion landing gear for increased load capacity, (4) the use of airdrop techniques for increasing efficiency, and (5) the selection of power plants. Diagrams and illustrations of proposed aircraft configurations are provided. Author

N74-33447# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
AIRCRAFT ACCIDENT REPORT: TRANS WORLD AIRLINES, INCORPORATED, BOEING 707-131B, N757TW, LOS ANGELES, CALIFORNIA, 16 JANUARY 1974
14 Aug. 1974 30 p
(NTSB-AAR-74-10) Avail: NTIS HC $4.50

An aircraft accident caused by the collapse of the nose gear on a Boeing 707 aircraft during landing after a night visual approach to the Los Angeles airport is discussed. Injuries to eight passengers were incurred during the emergency exit and the aircraft was destroyed by fire. The cause of the accident was determined to be continuation of a visual approach after the external visual reference was lost due to low cloud and fog. Author

N74-33448*# Massachusetts Inst. of Tech., Cambridge. Measurement Systems Lab.
DIGITAL FLIGHT CONTROL RESEARCH Final Report
J. E. Potter, R. G. Stern, T. B. Smith, and P Sinha Washington NASA Aug. 1974 211 p refs
(Contract NAS1-10677)
(NASA-CR-2433) Avail: NTIS HC $5.75 CSCL 01C

The results of studies which were undertaken to contribute to the design of digital flight control systems, particularly for transport aircraft are presented. In addition to the overall design considerations for a digital flight control system, the following topics are discussed in detail: (1) aircraft attitude reference system design, (2) the digital computer configuration, (3) the design of a typical digital autopilot for transport aircraft, and (4) a hybrid flight simulator. Author

N74-33452*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A FLIGHT INVESTIGATION WITH A STOL AIRPLANE FLYING CURVED, DESCENDING INSTRUMENT APPROACH PATHS
Margaret S. Benner, Milton D. McLaughlin, Richard H. Sawyer, Roger VanGunst, and John L. Ryan Washington Oct. 1974 54 p refs
(NASA-TN-D-7669; L-9549) Avail: NTIS HC $3.75 CSCL 01C

A flight investigation using a De Havilland Twin Otter airplane was conducted to determine the configurations of curved, 6 deg descending approach paths which would provide minimum airspace usage within the requirements for acceptable commercial STOL airplane operations. Path configurations with turns of 90 deg, 135 deg, and 180 deg were studied; the approach airspeed was 75 knots. The length of the segment prior to turn, the turn radius, and the length of the final approach segment were varied. The relationship of the acceptable path configurations to the proposed microwave landing system azimuth coverage requirements was examined. Author

N74-33453*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
OPTIMAL AND SUBOPTIMAL CONTROL TECHNIQUE FOR AIRCRAFT SPIN RECOVERY
John W. Young Washington Oct. 1974 29 p refs
(NASA-TN-D-7714; L-9625) Avail: NTIS HC $3.25 CSCL 01B

An analytic investigation has been made of procedures for effecting recovery from equilibrium spin conditions for three assumed aircraft configurations. Three approaches which utilize conventional aerodynamic controls are investigated. Included are a constant control recovery mode, optimal recoveries, and a suboptimal control logic patterned after optimal recovery results. The optimal and suboptimal techniques are shown to yield a significant improvement in recovery performance over that attained by using a constant control recovery procedure. Author

N74-33455*# Boeing Commercial Airplane Co., Seattle, Wash.
STATIC NOISE TESTS ON AUGMENTOR WING JET STOL RESEARCH AIRCRAFT (C8A BUFFALO)
C. C. Marrs, D. L. Harkonen, and J. V. OKeefe May 1974 102 p refs
(Contract NAS2-7641)
(NASA-CR-137520; D6-41324-1) Avail: NTIS HC $8.25 CSCL 01C

Results are presented for full scale ground static acoustic tests of over-area conical nozzles and a lobe nozzle installed on the Augmentor Wing Jet STOL Research Aircraft, a modified C8A Buffalo. The noise levels and spectrums of the test nozzles are compared against those of the standard conical nozzle now in use on the aircraft. Acoustic evaluations at 152 m (500 ft), 304 m (1000 ft), and 1216 m (4000 ft) are made at various engine power settings with the emphasis on approach and takeoff power. Appendix A contains the test log and propulsion calculations. Appendix B gives the original test plan, which was closely adhered to during the test. Appendix C describes the acoustic data recording and reduction systems, with calibration details. Author

N74-33456*# Boeing Commercial Airplane Co., Seattle, Wash.
TEST OF ACOUSTIC TONE SOURCE AND PROPULSION PERFORMANCE OF C8A BUFFALO SUPPRESSOR NOZZLE
C. C. Marrs, D. L. Harkonen, and J. V. OKeefe May 1974 408 p refs
(Contract NAS2-7641)
(NASA-CR-137521; D6-41324-2) Avail: NTIS HC $23.50 CSCL 01C

Results are presented for a static acoustic and propulsion performance ground test conducted at the Boeing hot nozzle facility on the C8A Buffalo noise suppressor nozzle. Various methods to remove a nozzle-associated 2000-Hz tone are evaluated. Results of testing this rectangular-array lobed nozzle for propulsion performance and acoustic directivity are reported. Recommendations for future nozzle modifications and further testing are included. Appendix A contains the test plan. Appendix B presents the test log. Appendix C contains plots of the one-third octave sound pressure levels recorded during the test. Appendix D describes the acoustic data recording and reduction systems. The performance data is tabulated in Appendix E. Author

N74-33457# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Flugzeugsteuerung und- Regelung.
COMPARISON WITH REGARD TO THE ECONOMY OF A DIGITAL AND AN ANALOG ELECTRO-HYDRAULIC

ACTUATOR
Claus Brinckmann Porz 23 May 1973 21 p refs In GERMAN; ENGLISH summary
(DLR-FB-73-105) Avail: NTIS HC $4.25; DFVLR, Porz, West Ger. 8 DM

A digital hydraulic actuator for linear motion, consisting of cylinders in series, is compared with an analog servo-actuator with the comsumption of pressurized oil as an index for economic operation. A description is given for the economic boundaries in general and for the special case as an actuator in aircraft control systems. Author (ESRO)

N74-33458# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Flugzeugsteuerung und -Regelung. pop Porz
CONTRIBUTION TO THE DYNAMIC BEHAVIOR OF A DIGITAL ELECTRO-HYDRAULIC ACTUATOR
Claus Brinckmann 14 Jun. 1973 55 p refs In GERMAN; ENGLISH summary
(DLR-FB-73-106) Avail: NTIS HC $5.75; DFVLR, Porz, West Ger. 13.50 DM

A method of temporary hydraulic locking is described for a digital electrohydraulic linear actuator, consisting of cylinders in series. The digital actuator concept has been developed for fly by wire aircraft control using digital electric signal transmission. The locking principle described avoids initial motion in the wrong direction even for loaded conditions of the actuator. ESRO

N74-33459# Air Force Flight Test Center, Edwards AFB, Calif.
BACKGROUND INFORMATION AND USER GUIDE FOR MIL-S-83691 Final Report
Patrick S. Sharp and Collet E. McElroy Mar. 1974 109 p refs
(AD-780523; AFFTC-TD-73-2) Avail: NTIS CSCL 15/7

The report is the Background Information and User Guide (BIUG) for Military Specification MIL-S-83691A (USAF), Stall/Post-Stall/Spin Flight Test Demonstration Requirements for Airplanes. The purposes of the BIUG are: to provide an aid in the interpretation and application of MIL-S-83691A (USAF), and to establish guidelines by which a flight test program can be planned, conducted and reported according to the demonstration specification. It is only an explanatory document and is therefore not contractually binding. However, since the BIUG does amplify upon the intent of the requirements and other provisions of MIL-S-83691A (USAF), it should be considered as a useful tool in the proper technical and contractual application of the flight test specification. Author (GRA)

N74-33460# Northrop Corp., Hawthorne, Calif. Aircraft Div.
ADVANCED METALLIC STRUCTURE: AIR SUPERIORITY FIGHTER WING DESIGN FOR IMPROVED COST, WEIGHT AND INTEGRITY. VOLUME 3: MATERIALS TEST PROGRAM Final Report, Oct. 1972 - Mar. 1973
Fred A. Figge Jun. 1973 183 p refs
(Contract F33615-72-C-1891; AF Proj. 406U)
(AD-781812; NOR-73-82-Vol-3; AFFDL-TR-73-52-Vol-3) Avail: NTIS CSCL 01/3

The portion of the Phase 1A Program assessed some of the new alloys and heat treatments which could become production materials within the next few years. The alloys and product forms were selected based upon their mechanical properties and their potential usefulness in a thin fighter-wing structure. GRA

N74-33461# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
TAKEOFF AND LANDING ANALYSIS COMPUTER PROGRAM (TOLA). PART 3: USERS MANUAL
Urban H. D. Lynch and John J. Dueweke Apr. 1974 102 p ref
(AD-781758; AFFDL-TR-71-155-Pt-3) Avail: NTIS CSCL 01/2

TOLA is an acronym for TakeOff and Landing Analysis digital computer program. This part describes the use of the program. The basic program provides six rigid-body degrees of freedom of aerospace vehicle motion over a flat planet and determines the response of the aircraft to control inputs. The dynamics of up to five independent oleo-type struts are included for simulation of symmetrical and nonsymmetrical landings as well as drop tests. A maneuver logic is programmed to provide vehicle guidance in the various phases of the problem; it determines the desired trim and position in the glide slope and provides synthesis and attempted completion of necessary flare dynamics for prescribed touchdown velocity vector. The landing roll includes wheel spinup and braking, thrust reversing, spoiler deployment, and system failure options. The takeoff roll consists of acceleration to takeoff speed, followed by rotation to takeoff angle of attack. (Modified author abstract) GRA

N74-33462# General Dynamics/Fort Worth, Tex. Convair Aerospace Div.
ADVANCED METALLIC STRUCTURES: AIR SUPERIORITY FIGHTER WING DESIGN FOR IMPROVED COST, WEIGHT AND INTEGRITY. VOLUME 2: DESIGN DATA Final Report, 15 Jun. 1972 - 15 Jun. 1973
D. F. Davis Jul. 1973 565 p
(Contract F33615-72-C-2149)
(AD-781807; AFFDL-TR-73-50-Vol-2) Avail: NTIS CSCL 01/3

During the initial step of the Concept Formulation Phase, one-hundred nineteen (119) Element Concepts were documented. An additional twenty-seven (27) concepts were generated during the cross-section drawing phase of the program. Their weight saving potential was established as part of this effort. Evaluation and utilization of these concepts were based on qualitative and quantitative data discussed in this report. Manufacturing and NDI evaluations were basically qualitative, generally relying on comparison to known industry standards. The wing skin panel concepts were analyzed using a computer program created especially for this effort. GRA

N74-33463# General Dynamics/Fort Worth, Tex. Convair Aerospace Div.
ADVANCED METALLIC STRUCTURES: AIR SUPERIORITY FIGHTER WING DESIGN FOR IMPROVED COST, WEIGHT AND INTEGRITY. VOLUME 3: STRESS, FATIGUE AND FRACTURE, COST AND MATERIAL DATA Final Report, 15 Jun. 1972 - 15 Jun. 1973
D. F. Davis et al Jul. 1973 362 p refs
(Contract F33615-72-C-2149)
(AD-781808; AFFDL-TR-73-50-Vol-3) Avail: NTIS CSCL 01/3

This section presents the portion of results of the flight loads buildup and demonstration tests for the F-111 with no external stores as applicable to the F-111F wing. The entire test program results are reported in Reference 1. These balanced symmetric flight tests were accomplished on F-111A No. 13 and F-111A No. 75. These tests were accomplished to establish the maximum load levels encountered in flight. The ultimate objective of such testing is to show that the loads used for design and the loads applied in static test are adequate. GRA

N74-33464# General Dynamics/Fort Worth, Tex. Convair Aerospace Div.
ADVANCED METALLIC STRUCTURES: AIR SUPERIORITY FIGHTER WING DESIGN FOR IMPROVED COST, WEIGHT AND INTEGRITY. VOLUME 4: BASELINE DAMAGE TOLERANCE EVALUATION Final Report, 15 Jun. 1972 - 15 Jun. 1973
D. F. Davis Jul. 1973 749 p
(AD-781809; AFFDL-TR-73-50-Vol-4) Avail: NTIS CSCL 01/3

The basic objective of this study was to provide an updated analysis of the F-111F baseline wing box reflecting the latest proposed Air Force version of damage tolerance criteria. In addition, sensitivity and trade studies were made on the baseline. The effect on allowable stress and service life due to variation in Klc, da/dN, initial damage assumptions, and service usage

were determined. NDI experience, thermal and chemical environment, and the impact of a fracture control plan were studied. Baseline data on inspection experience was compiled. The impact on stress levels and life of varying the residual strength load requirement was determined. GRA

N74-33466# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.
SUBSONIC WIND TUNNEL INVESTIGATION OF THE HIGH LIFT CAPABILITY OF A CIRCULATION CONTROL WING ON A 1/5-SCALE T-2C AIRCRAFT MODEL
Robert J. Englar May 1973 71 p refs
(AD-781856; TN-AL-299) Avail: NTIS CSCL 01/1

A circulation control wing, formed by the deflection of a 15% chord flap through 180 degrees to produce a circular cylinder trailing edge with tangential upper surface blowing, was applied to a 1/5-scale T-2C aircraft model. The flap span/wing span ratio was 0.495, consistent with the conventional aircraft. Subsonic investigations were conducted in the Naval Ship Research and Development Center (NSRDC) 8- by 10-foot North Wind Tunnel over a dynamic pressure range of 5 to 41 psf (Reynolds number based on mean aerodynamic chord of 0.60 to 1.68 million). Flap deflection was varied from 0 to 180 degrees, thus comparing the configurations of blown flap (moderate-to-high lift and lower drag for take-off) and the circular Coanda trailing edge (high lift and high drag for landing). (Modified author abstract) GRA

N74-33468# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.
STRUCTURAL DYNAMIC RESPONSE OF AH-1G WING WITH XM35 WEAPON Final Report, Dec. 1972 - Apr. 1973
Adam R. Zak Nov. 1973 53 p refs
(Contract DAHC04-72-A-0001; DA Proj. 1F1-62201-D-025)
(AD-781973; RIA-R-RR-T-6-58-73) Avail: NTIS CSCL 01/3

The report contains an analysis and the numerical results which have been developed for predicting dynamic response of flexible helicopter structures excited by the recoil force of the XM35 weapon. This report is in four parts. The first part contains the analysis of the wing-gun combination alone. The wing is assumed to be clamped rigidly at its root. The recoil force is divided into three components which include the mean force, the sinusoidal component, and the random component. The wing is treated as a flexible structure with lumped masses. The second part of the report contains the analysis of the wing-gun combination but the wing is assumed to be supported elastically at its root. The third part contains the analysis of the total wing-gun combination plus the remaining helicopter structure by the Statistical Energy Analysis (SEA) method. The fourth part of the report describes a computer program which has been developed and the numerical results which have been obtained using the analysis in part one of this report. (Modified author abstract) GRA

N74-33470# Aerospace Systems, Inc., Burlington, Mass.
A STUDY OF TECHNIQUES FOR REAL-TIME, ON-LINE OPTIMUM FLIGHT PATH CONTROL. THREE DIMENSIONAL MINIMUM-TIME FLIGHT PATHS WITH TWO STATE VARIABLES Interim Report, Dec. 1972 - Nov. 1973
Arthur E. Bryson, Jr., William C. Hoffman, and Chen-Chung Hsin Jan. 1974 37 p refs
(Contract F44620-72-C-0001; AF Proj. 9769)
(AD-782490; ASI-TR-74-18; AFOSR-74-1041TR) Avail: NTIS CSCL 01/2

A study of three-dimensional, minimum-time turning maneuvers for supersonic fighter aircraft is described. For turns which do not specify the end-point position, the optimum maneuvers comprise a one-parameter family of flight paths. All the optimum turns, and their associated control variables can be presented in simple graphical form for a specified aircraft configuration. A feedback control diagram can be easily constructed for all minimum-time turns to a specified final energy level. This feedback chart could be implemented in the airborne computer to provide real-time, on-line optimal flight path control. Numerical results for an early model of the F4 fighter illustrate the control technique. Author (GRA)

N74-33471# Instrument Flight Center, Randolph AFB, Tex.
HELICOPTER PROCEDURAL INNOVATIONS (UNUSUAL ATTITUDES) Final Report
Don L. Baker 21 May 1974 8 p
(IFC Proj. TR/D-74-1)
(AD-782204; IFC-LR-74-3) Avail: NTIS CSCL 01/2

Responding to the recommendations of a HQ USAF All-Commands Helicopter Conference, USAF Instrument Flight Center has initiated a Helicopter Procedural Innovations Program. One phase of the Procedural Innovations Program has addressed helicopter unusual attitude recovery techniques. At the present time, there are no unusual attitude recovery techniques in AFM 51-37 that specifically address rotary-wind aircraft. Although the techniques found in AFM 51-37 are adequate for fixed-wing unusual attitude recoveries, portions need amplification to apply to helicopter recoveries. This is due to the unique aerodynamics of rotary-wing aircraft, as well as a different application of the control and performance concept to helicopters as compared to fixed-wing aircraft. GRA

N74-33472# Bell Helicopter Co., Fort Worth, Tex.
MANEUVER CRITERIA EVALUATION PROGRAM
T. L. Wood, D. G. Ford, and G. H. Brigman May 1974 143 p
(Contract DAAJ02-73-C-0015; DA Proj. 1F2-62208-AH-9001)
(AD-782209; USAAMRDL-TR-74-32) Avail: NTIS CSCL 01/3

The Maneuver Criteria Evaluation Program (MCEP) is a digital computer program which solves the flight path equation of motion for a helicopter without auxiliary propulsion. The use of basic work, energy, and power relationships makes possible accurate representation of flight path trajectories. MCEP can be used to aid in the development of maneuver requirements which provide the necessary maneuver capability to perform the desired mission. This report presents a review of the program capabilities in addition to the background and development of the principal mathematical model in MCEP. A demonstration of MCEP is provided using a typical AH-1G helicopter gunship mission. (Modified author abstract) GRA

N74-33473# Douglas Aircraft Co., Inc., Long Beach, Calif.
DEVELOPMENT OF A GRAPHITE HORIZONTAL STABILIZER Interim Technical Report, Jul. 1973 - 28 Feb. 1974
George M. Lehman Apr. 1974 46 p refs
(Contract N00156-70-C-1321)
(AD-782646; MDC-J6507; ITR-8) Avail: NTIS CSCL 01/3

The final assembly bonding, nondestructive inspection, and static testing of the second graphite-epoxy horizontal stabilizer for the A4 Skyhawk are discussed. The fit checks, bonding technique, and Fokker bond test results for the final assembly bond of the upper skin panel are described. Strain data are presented for static tests in two critical load conditions (i.e., maximum elevator load and maximum stabilizer load). Predicted and actual strain plots indicating good correlation are presented for selected strain gages. During ultimate load tests, the stabilizer sustained some structural damage as indicated by significant strain redistributions within the structure. The cause of the damage, a delamination of the front-spar lower attach angle, was diagnosed as a local eccentricity in load pathe (omission of a shear clip on one side of the front-spar shear web) at a critical location where a high local test load was applied. A rework plan is presented to remove the eccentricity and repair the damaged structure prior to resumption of testing.
Author (GRA)

N74-33648# Test Group (6585th), Holloman AFB, N.Mex.
STATIC RADAR CROSS SECTION OF LIGHT AIRCRAFT. VOLUME 1: CESSNA 150 L AT L-, S-, AND C-BANDS Final Report
Dec. 1973 284 p refs
(AD-781825; AFSWC-TR-73-46-Vol-1; FAA-RD-74-99-1) Avail: NTIS CSCL 17/9

Static radar cross section (RCS) of a single-engine Cessna 150L utility aircraft was measured at 2700, 2800, and 2900 MHz over a range of aircraft attitudes of plus or minus 10 degrees pitch, 0 degrees to 45 degrees roll, and also at 1250, 1350, 5000, and 5400 MHz at 0 degrees roll, 0 degrees pitch. Median RCS was independent of frequency in linear polarization but not in circular polarization. At S-Band the median RCS was nearly independent of roll and pitch except in the two broadside directions. In those two directions at roll angles between 20 degrees and 45 degrees median RCS was 6 db to 10 db greater when viewing the aircraft upper surface than when the radar aspect was into the lower surfaces of wing and fuselage at the same roll angle. Author (GRA)

N74-33652# Test Group (6585th), Holloman AFB, N.Mex.
STATIC RADAR CROSS SECTION OF LIGHT AIRCRAFT. VOLUME 2: CHEROKEE 140 AT L-, S-, AND C-BANDS ***Final Report***
Dec. 1973 265 p Prepared in cooperation with Dynalectron Corp.
(Contract F29601-73-C-0133)
(AD-781791; AFSWC-TR-73-46-Vol-2) Avail: NTIS CSCL 17/9

Static radar cross section (RCS) of a single-engine low-wing Piper PA-28-140 Cherokee (Cherokee 140) was measured at 2700, 2800, and 2900 MHz (S-Band) over a range of aircraft attitudes of plus or minus 10 degrees pitch, 0 degrees to 45 degrees roll, and also at 1250, 1350, 5000, and 5400 MHz at 0 degrees roll, 0 degrees pitch. Median RCS in circular polarization and in linear polarization was independent of frequency. At S-Band the median RCS varied with roll angle most strongly in the two broadside directions. In those two directions the variation was greatest for linear polarization when the radar viewed the lower surface of the aircraft, and was greatest for circular polarization when the radar viewed the upper surface of the aircraft. Median RCS at S-Band was not affected by pitch angle. Author (GRA)

N74-33653# *Test Group (6585th), Holloman AFB, N.Mex.*
STATIC RADAR CROSS SECTION OF LIGHT AIRCRAFT. VOLUME 3: PIPER PA-18 SUPER CUB AT L-, S-, AND C-BANDS Final Report
Jan. 1974 269 p refs
(AD-781792; AFSWC-TR-73-46-Vol-3) Avail: NTIS CSCL 17/9

Static radar cross section (RCS) of a single-engine fabric-covered Piper PA-18 Super Cub high wing monoplane was measured at 2700, 2800 and 2900 MHz over a range of aircraft attitudes of plus or minus 10 degrees pitch, 0 degrees to 45 degrees roll, and also at 1250, 1350, 5000, and 5400 MHz at 0 degrees roll, 0 degrees pitch. Median RCS was independent of frequency in linear polarization and in circular polarization. The RCS was insensitive to roll, pitch, and yaw except in the two broadside directions under conditions of increasing roll angle. The report includes copies of the original recorded RCS patterns. Author (GRA)

N74-33750# California Univ., Livermore. Lawrence Livermore Lab.
EMP-ENDUCED SKIN CURRENTS ON AIRCRAFT
J. A. Landt and E. K. Miller 1 Feb. 1974 11 p refs Presented at G-AP Intern. Symp., Atlanta, 10 Jun. 1974 Submitted for publication Sponsored by AEC
(UCRL-75426; Conf-740602-1) Avail: NTIS HC $4.00

The theory and numerical approach to determine the electric current flowing on the outer skin of an aircraft when illuminated by EMP is reported. The numerical solution of a thin wire, time dependent, integral equation is presented with subsequent predictions for the bulk axial skin currents on several aircraft excited by an EMP wave. M.C.F.

N74-34076# Pratt and Whitney Aircraft, East Hartford, Conn.
ADVANCED CERAMIC SEAL PROGRAM, PHASE 1 Final Report, 15 Aug. 1972 - 30 Sep. 1973
P. W. Schlike Apr. 1974 60 p refs
(Contract N00140-73-C-0320)
(AD-781004; PWA-6635) Avail: NTIS CSCL 11/2

Screening of candidate ceramic seal materials was conducted to select the most promising systems for turbine seal component development. Vendor screening coupled with a literature search and preliminary thermal analysis identified five ceramic seal systems and one blade tip system for testing and evaluation in this contract. The ceramic seal materials were divided into two categories (1) insulative ceramic materials which could be applied to a metallic substrate and (2) structural ceramic materials to be mechanically held in place. Yittria stabilized zirconia was selected as the primary insulative ceramic material and reaction sintered silicon nitride was selected as the primary structural ceramic material to be used in these systems. Physical properties measurements of coefficient of thermal expansion, thermal conductivity, and modulus of elasticity were performed on the selected seal materials. Thermal shock, oxidation/erosion and abradability were conducted on the seal and blade tip systems. Analysis of the test results and thermal and stress analysis under advanced engine conditions resulted in the selection of the best graded metal/ceramic system and the best structural system for turbine seal component development. Hot pressed silicon nitride and hot pressed silicon carbide were also analyzed for thermal and stress levels under advanced engine conditions. The recommended systems are: System 3 (yittria/calcia stabilized zirconia graded with a nickel chromium metallic constituent and brazed to a metallic substrate) and hot pressed silicon carbide. Author (GRA)

N74-34154*# Scientific Translation Service, Santa Barbara, Calif.
FLIGHT OPERATIONS AND GUIDE BEAM SYSTEMS
T. Bohr Washington NASA Oct. 1974 24 p *Transl. into* ENGLISH from the German report DGLR-73-011 Presented at the DGLR DGON Symp. on Neue Anflug- und Landeverfahren, Duesseldorf, 2-4 May 1973
(Contract NASw-2483)
(NASA-TT-F-15962; DGLR-73-011) Avail: NTIS HC $4.25 CSCL 17G

The history and perspectives of the instrument landing system are presented. The present operational requirements for these systems, as endorsed by the ICAO, are formulated and discussed. The configuration of the ILS is discussed to show the components involved. Examples of the instrument landing systems are illustrated. Author

N74-34446+ Engineering Sciences Data Unit, London (England).
METHOD FOR PREDICTING THE PRESSURE DISTRIBUTION ON SWEPT WINGS WITH SUBSONIC ATTACHED FLOW
Jun. 1973 65 p refs Supersedes ESDU-TD-Memor-6312 Sponsored by Min. of Def. and Roy. Aeron. Soc.
(ESDU-73012; ESDU-TD-Memor-6312) Copyright. Avail: NTIS HC $314.50

A formula which is used to predict the pressure distribution on swept wings at subsonic speeds is presented. The method is based on the linearized theory for certain special cases with the most important nonlinear terms taken into account so that wings of moderate thickness can be dealt with. The basic formula is quoted for compressible flow. The corresponding formula for incompressible flow is explained. The application of the method to wings in combination with fuselages and other bodies is outlined. A means of replacing the approximate calculation of the linear theory perturbation velocities due to thickness and lift by values obtained from the numerical methods is analyzed. Author

N74-34447+ Engineering Sciences Data Unit, London (England).
ADAPTATION OF DRAG-RISE CHARTS IN T. D. MEMOR. 71019 TO THE MID-SEMI-SPAN PORTION OF SWEPT AND TAPERED PLANFORMS
Nov. 1972 15 p refs Sponsored by Min. of Def. and Roy. Aeron. Soc.
(ESDU-72027) Copyright. Avail: NTIS HC $74.50

The design of aircraft wings to achieve a desired cruise design point without the occurrence of shock wave drag, but beyond which point the onset of shock wave drag is anticipated is discussed. The design point is by definition the drag-rise condition represented by the coefficient of lift and the drag-rise Mach number Two dimensional flow conditions for a family of airfoils that have a particular form of upper surface pressure distribution at the drag-rise condition are analyzed. The modifications to the basic equations for three dimensional flow conditions are explained. Author

N74-34459*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXTENSION OF LEADING-EDGE-SUCTION ANALOGY TO WINGS WITH SEPARATED FLOW AROUND THE SIDE EDGES AT SUBSONIC SPEEDS
John E. Lamar Washington Oct. 1974 73 p refs
(NASA-TR-R-428; L-9460) Avail: NTIS HC $3.75 CSCL 01A

A method for determining the lift, drag, and pitching moment for wings which have separated flow at the leading and side edges with subsequently reattached flow downstream and inboard is presented. Limiting values of the contribution to lift of the side-edge reattached flow are determined for rectangular wings. The general behavior of this contribution is computed for rectangular, cropped-delta, cropped-diamond, and cropped-arrow wings. Comparisons of the results of the method and experiment indicate reasonably good correlation of the lift, drag, and pitching moment for a wide planform range. The agreement of the method with experiment was as good as, or better than, that obtained by other methods. The procedure is computerized and is available from COSMIC as NASA Langley computer program A0313. Author

N74-34461*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF AN EXTERNALLY BLOWN FLAP POWERED LIFT MODEL WITH SEVERAL PROPULSIVE SYSTEM SIMULATORS
Danny R. Hoad Washington Sep. 1974 143 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Hampton, Va.
(NASA-TN-D-7670; L-9538) Avail: NTIS HC $4.75 CSCL 01C

An investigation of a four-engine externally blown flap (EBF) powered-lift transport was conducted in the Langley V/STOL tunnel to determine the effect of different engine configurations on the longitudinal aerodynamic characteristics. The different engine configurations were simulated by five different sets of propulsion simulators on a single aircraft model. Longitudinal aerodynamic data were obtained for each simulator on each flap deflection corresponding to cruise, take-off, and landing at a range of angles of attack and various thrust coefficients. The bypass ratio (BPR) 6.2 engine simulator provided the best lift and drag characteristics of the five simulators tested in the take-off and landing configurations. The poor performance of the BPR 10.0 and 3.2 engine simulators can be attributed to a mismatch of engine-model sizes or poor engine location and orientation. Isolated engine wake surveys indicated that a reasonable assessment of the aerodynamic characteristics of an engine-wing-flap configuration could be made if qualitative information were available which defined the engine wake characteristics. All configurations could be trimmed easily, with relatively small horizontal-tail incidence angles; however, the take-off landing configurations required a high-lift tail. Author

N74-34462*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND-TUNNEL INVESTIGATION OF AN EXTERNALLY BLOWN FLAP STOL TRANSPORT MODEL INCLUDING AND INVESTIGATION OF WALL EFFECTS
Garl L. Gentry, Jr. Washington Sep. 1974 174 p refs
(NASA-TM-X-3009) Avail: NTIS HC $5.00 CSCL 01A

A wind-tunnel investigation was conducted in the Langley V/STOL tunnel and in a scaled version of the Ames 40- by 80-foot tunnel test section installed as a liner in the Langley V/STOL tunnel to determine the effect of test-section size on aerodynamic characteristics of the model. The model investigated was a swept-wing, jet-powered, externally blown flap (EBF) STOL transport configuration with a leading-edge slat and triple-slotted flaps. The model was an 0.1645-scale model of a 11.58-meter (38.0-ft) span model designed for tests in a 40- by 80-foot tunnel. The data compare the aerodynamic characteristics of the model with and without the tunnel liner installed. Data are presented as a function of thrust coefficient over an angle-of-attack range of 0 deg to 25 deg. A thrust-coefficient range up to approximately 4.0 was simulated, most ot the tests being conducted at a free-stream dynamic pressure of 814 Newtons/sq m (17 lb sq ft). The data are presented with a minimum of analysis. Author

N74-34464 † Engineering Sciences Data Unit, London (England).
LOST RANGE, FUEL AND TIME DUE TO CLIMB AND DESCENT: AIRCRAFT WITH TURBO-JET AND TURBO-FAN ENGINES
Aug. 1974 13 p refs Sponsored by Roy. Aeron. Soc.
(ESDU-74018) Copyright. Avail: NTIS HC $36.00

An approximate method for estimating lost range, lost fuel and lost time due to climb and descent is presented. The use of these quantities permits estimates of still-air range, fuel and time based on cruise performance alone to be adjusted for the net loss of energy during climb (including acceleration) and descent (including deceleration). The method is best suited to preliminary calculations at a stage when the available airframe and engine data are minimal and for cases where the distances flown in climb and descent are not a substantial part of the total flight distance. Author

N74-34465*# Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
AIRCRAFT RANGE OPTIMIZATION USING SINGULAR PERTURBATIONS Ph.D. Thesis
Joseph Taffe OConnor Jun. 1973 180 p refs
(Contract NAS9-4065; DSR Proj. 55-23890)
(NASA-CR-140519; T-597) Avail: NTIS HC $12.00 CSCL 01B

An approximate analytic solution is developed for the problem of maximizing the range of an aircraft for a fixed end state. The problem is formulated as a singular perturbation and solved by matched inner and outer asymptotic expansions and the minimum principle of Pontryagin. Cruise in the stratosphere, and on transition to and from cruise at constant Mach number are discussed. The state vector includes altitude, flight path angle, and mass. Specific fuel consumption becomes a linear function of power approximating that of the cruise values. Cruise represents the outer solution; altitude and flight path angle are constants, and only mass changes. Transitions between cruise and the specified initial and final conditions correspond to the inner solutions. The mass is constant and altitude and velocity vary. A solution is developed which is valid for cruise but which is not for the initial and final conditions. Transforming of the independent variable near the initial and final conditions result in solutions which are valid for the two inner solutions but not for cruise. The inner solutions can not be obtained without simplifying the state equations. The singular perturbation approach overcomes this difficulty. A quadratic approximation of the state equations is made. The resulting problem is solved analytically, and the two inner solutions are matched to the outer solution. Author

N74-34466*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PARAMETER ESTIMATION OF POWERED-LIFT STOL AIRCRAFT CHARACTERISTICS INCLUDING TURBULENCE AND GROUND EFFECTS
Rodney C. Wingrove Sep. 1974 11 p refs
(NASA-TM-X-62382) Avail: NTIS HC $3.00 CSCL 01C

The estimation of longitudinal aerodynamic coefficients from data recorded during flight tests of a powered-lift STOL aircraft is considered. First, a comparison is made between the coefficient values determined by the regression and quasilinearization identification techniques from records taken during elevator pulse

maneuvers. The results show that for these tests the regression method provides less scatter in coefficient estimates and provides better correlation with ,the predicted values. Special techniques are then developed which allow identification of the coefficients from records taken during landing maneuvers in which the aircraft encounters turbulence while flying in ground effect. Flight test results are presented to illustrate the effects of air turbulence and ground proximity on the estimated coefficient values.
Author

N74-34467*# Boeing Commercial Airplane Co., Seattle, Wash.
THE RESULTS OF A LOW-SPEED WIND TUNNEL TEST TO INVESTIGATE THE EFFECTS OF THE REFAN JT8D ENGINE TARGET THRUST REVERSER ON THE STABILITY AND CONTROL CHARACTERISTICS OF THE BOEING 727-200 AIRPLANE
E. A. Kupcis Jul. 1974 52 p
(Contract NAS3-17842)
(NASA-CR-134699; BCAC-D6-41908) Avail: NTIS HC $5.75 CSCL 01C

The effects of the Refan JT8D side engine target thrust reverser on the stability and control characteristics of the Boeing 727-200 airplane were investigated using the Boeing-Vertol 20 x 20 ft Low-Speed Wind Tunnel. A powered model of the 727-200 was tested in groud effect in the landing configuration. The Refan target reverser configuration was evaluated relative to the basic production 727 airplane with its clamshell-deflector door thrust reverser design. The Refan configuration had slightly improved directional control characteristics relative to the basic airplane. Clocking the Refan thrust reversers 20 degrees outboard to direct the reverser flow away from the vertical tail, had little effect on directional control. However, clocking them 20 degrees inboard resulted in a complete loss of rudder effectiveness for speeds greater than 90 knots. Variations in Refan reverser lip/fence geometry had a minor effect on directional control.
Author

N74-34468*# Aeronautical Research Associates of Princeton, Inc., N.J.
SURVEY OF AIRCRAFT SUBCRITICAL FLIGHT FLUTTER TESTING METHODS
Robert Rosenbaum Aug. 1974 30 p refs
(Contract NAS1-11672)
(NASA-CR-132479; ARAP-218) Avail: NTIS HC $3.25 CSCL 01C

The results of a survey of U. S., British and French subcritical aircraft flight flutter testing methods are presented and evaluation of the applicability of these methods to the testing of the space shuttle are discussed. Ten U. S. aircraft programs covering the large civil transport aircraft and a variety of military aircraft are reviewed. In addition, three major French and British programs are covered by the survey. The significant differences between the U. S., French and British practices in the areas of methods of excitation, data acquisition, transmission and analysis are reviewed. The effect of integrating the digital computer into the flight flutter test program is discussed. Significant saving in analysis and flight test time are shown to result from the use of special digital computer routines and digital filters.
Author

N74-34469*# McDonnell-Douglas Corp., Long Beach, Calif.
AN ANALYSIS OF THE IMPACT OF CABIN FLOOR ANGLE RESTRICTIONS ON L/D FOR A TYPICAL SUPERSONIC TRANSPORT
R. L. Radkey Aug. 1974 54 p refs
(Contract NAS1-13145)
(NASA-CR-132508) Avail: NTIS HC $3.75 CSCL 01C

High floor angles at cruise have been identified as a significant problem facing airline and public acceptance of a supersonic transport. In order to explore the relationship between cruise performances and floor angle, four related wing-fuselage design and integration studies have been conducted. The studies were: (1) a fuselage camber study in which perturbations in the fuselage camber distribution were examined with a baseline wing, (2) a wing optimization study in which wings were optimized for minimum drag at C sub L's less than the design C sub L. These wings were optimized as wing planform camber surfaces alone and evaluated with a baseline fuselage, (3) a second wing optimization study in which wings were optimized for minimum drag at C sub L's less than the design C sub L but for this study the wings were optimized in the presence of the baseline fuselage, and (4) a third wing optimization study in which wings were optimized for minmum drag subject to C sub M constraints designed to produce more positive C sub MO's, thereby reducing trim drag. The studies indicated that it was not possible to both improve the aircraft cruise L/D and substantially reduce the cruise floor angle. The studies did indicate that the cruise floor angle could be reduced by reducing the fuselage incidence relative to the wing, but the reduction in floor angle was accompanied by a substantial reduction in L/D.
Author

N74-34473# Committee on Science and Astronautics (U. S. House).
ADVANCED SUPERSONIC TECHNOLOGY
Washington GPO 1974 255 p Hearing before Subcomm. on Aeron. and Space Technol. of Comm. on Sci. and Astronaut., 93d Congr., 2d Sess., No. 39, 22 Feb. 1974
(GPO-39-784) Avail: Subcomm. on Aeron. and Space Technol.

The following subjects are examined: (1) fuel conservation measures for current and future subsonic aircraft, primarely from a technological point of view; (2) prospects and problems involving the use of hydrogen as an aviation fuel; and (3) the technological base for advanced supersonic flight.
G.G.

N74-34475*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HINGELESS HELICOPTER ROTOR WITH IMPROVED STABILITY Patent Application
Robert A. Ormiston, William G. Bousman, Dewey H. Hodges, and David A. Peters, inventors (to NASA) Filed 10 Oct. 1974 22 p Prepared in cooperation with Army Air Mobility R and D Lab.
(NASA-Case-ARC-10807-1; US-Patent-Appl-SN-513612) Avail: NTIS HC $4.25 CSCL 01B

Improved stability is provided in a hingeless helicopter rotor by inclining the principal elastic flexural axes and coupling pitching of the rotor blade with the lead-lag bending of the blade. The primary elastic flex axes can be inclined by constructing the blade of materials that display nonuniform stiffness. The specification describes various cross section distributions and the inclined flex axes resulting therefrom. Also described are arrangements for varying the pitch of the rotor blade in a predetermined relationship with lead-lag bending of the blade, i.e., bending of the blade in a plane parallel to its plane of rotation.
NASA

N74-34476*# Systems Technology, Inc., Hawthorne, Calif.
VEHICLE DESIGN CONSIDERATIONS FOR ACTIVE CONTROL APPLICATION TO SUBSONIC TRANSPORT AIRCRAFT Final Report
L. Gregor Hofmann and Warren F. Clement Washington NASA Aug. 1974 148 p refs Prepared in cooperation with McDonnell Douglas Astronautics Co., Huntington Beach, Calif.
(Contracts NAS1-12436; LS-2975-A3)
(NASA-CR-2408; TR-2037-1) Avail: NTIS HC $4.75 CSCL 01B

The state of the art in active control technology is summarized. How current design criteria and airworthiness regulations might restrict application of this emerging technology to subsonic CTOL transports of the 1980's are discussed. Facets of active control technology considered are: (1) augmentation of relaxed inherent stability; (2) center-of-gravity control; (3) ride quality control; (4) load control; (5) flutter control; (6) envelope limiting, and (7) pilot interface with the control system. A summary and appraisal of the current state of the art, design criteria, and recommended practices, as well as a projection of the risk in applying each of these facets of active control technology is given. A summary of pertinent literature and technical expansions is included.
Author

N74-34477*# Lockheed-Georgia Co., Marietta.
FEASIBILITY STUDY OF THE TRANSONIC BIPLANE CONCEPT FOR TRANSPORT AIRCRAFT APPLICATION
R. H. Lange, J. F. Cahill, E. S. Bradley, R. R. Eudaily, C. M. Jenness, and D. G. MacWilkinson Jun. 1974 138 p refs
(Contract NAS1-12413)
(NASA-CR-132462; LG74ER0077) Avail: NTIS HC $4.75 CSCL 01C

Investigations were conducted to evaluate the feasibility of a transonic biplane consisting of a forward-mounted swept-back lower wing, a rear-mounted swept-forward upper wing, and a vertical fin connecting the wings at their tips. This wing arrangement results in significant reductions in induced drag relative to a monoplane designed with the same span, and it allows for a constant-section fuselage shape while closely matching an ideal area distribution curve for M = 0.95 cruise. However, no significant reductions in ramp weight were achieved for the biplane relative to a monoplane with the same mission capability. Flutter analyses of the biplane revealed both symmetric and antisymmetric instabilities that occur well below the required flutter speed. Further studies will be required to determine if acceptable flutter speeds can be achieved through the elimination of the instabilities by passive means or by active controls. Configurations designed for other missions, especially those with lower Mach numbers and lower dynamic pressures, should be examined since the geometries suitable for those design constraints might avoid the weight penalties and flutter instabilities which prevent exploitation of induced drag benefits for the configuration studied. Author

N74-34480# National Aerospace Lab., Tokyo (Japan).
AN EXPERIMENTAL INVESTIGATION ON THE TRANSONIC FLUTTER CHARACTERISTICS OF THE CANTILEVER SWEPT-BACK WING WITH AIRFOIL SECTION AND COMPARISON WITH THE THIN CANTILEVER SWEPT-BACK WING
Toshiyuki Morita, Eiichi Nakai, and Takao Kikuchi 1974 13 p refs In JAPANESE; ENGLISH summary
(NAL-TR-361) Avail: NTIS HC $4.00

An experimental investigation on the transonic flutter characteristics of the cantilever swept-back wing was conducted in a transonic blow-down wind tunnel for flutter testing at Mach numbers from 0.756 to 0.978. The wing models used in the investigation have a swept-back angle of 20 deg at the quater-chord line, panel aspect ratio and taper ratio of 4.0 and 0.4, respectively, utilize the airfoil section of NACA 65A 0012, and include two kinds of configuration of the models, i.e., the clean wing and the wing with a mass of engine-pod shape. The boundaries of flutter-density and experimental flutter-speed coefficients are characterized by the minimum values at certain interim Mach numbers investigated. Also, the results obtained were compared with the previous results of flat-plate wings, and it was found that the wing with airfoil section had a stabilizing effect except in the case of the wing with a mass for high Mach number tested. Author

N74-34481*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FLIGHT-PATH AND AIRSPEED CONTROL DURING LANDING APPROACH FOR POWERED-LIFT AIRCRAFT
James A. Franklin and Robert C. Innis Washington Oct. 1974 63 p refs
(NASA-TN-D-7791; A-5389) Avail: NTIS HC $3.75 CSCL 01B

Manual control of flight path and airspeed during landing approach has been investigated for powered-lift transport aircraft. An analysis was conducted to identify the behavior of the aircraft which would be potentially significant to the pilot controlling flight path and airspeed during the approach. The response characteristics found to describe the aircraft behavior were (1) the initial flight-path response and flight-path overshoot for a step change in thrust, (2) the steady-state coupling of flight path and airspeed for a step change in thrust, and (3) the sensitivity of airspeed to changes in pitch attitude. The significance of these response characteristics was evaluated by pilots on a large-motion, ground-based simulator at Ames Research Center. Coupling between flight path and airspeed was considered by the pilot to be the dominant influence on handling qualities for the approach task. Results are compared with data obtained from flight tests of three existing powered-lift V/STOL aircraft. Author

N74-34482*# Lockheed-Georgia Co., Marietta.
NON-ENGINE AERODYNAMIC NOISE INVESTIGATION OF A LARGE AIRCRAFT Final Report
John S. Gibson Washington NASA Oct. 1974 56 p refs
(Contract NAS1-12443)
(NASA-CR-2378) Avail: NTIS HC $3.75 CSCL 01C

A series of flyover noise measurements have been accomplished utilizing a large jet transport aircraft with engine power reduced to flight idle. It was determined that the aerodynamic (nonengine) noise levels did occur in the general range that had been predicted by using small aircraft (up to 17,690 kg gross weight) prediction techniques. The test procedures used are presented along with discussions of the effects of aerodynamic configuration on the radiated noise, identification of noise sources, and predicted aerodynamic noise as compared with measuremets. Author

N74-34483*# Washington Univ., St. Louis, Mo. Dept. of Mechanical and Aerospace Engineering.
METHODS STUDIES TOWARD SIMPLIFIED ROTOR-BODY DYNAMICS, PART 1 First Yearly Report
K. H. Hohenemser and S. K. Yin Jun. 1974 63 p refs
(Contract NAS2-7613)
(NASA-CR-137570) Avail: NTIS HC $6.25 CSCL 01B

This report is directed to the problem of developing an adequate but not overly complex linear flight dynamics analytical model of a rotorcraft to study stability, control, gust and random turbulence responses. Since the conventional flight dynamics analysis using quasisteady rotor derivatives is adequate for the long period modes like the phugoid mode, only short time responses are considered here, where rotor-body coupling is of importance. Thus the body motion consists of pitch, roll and vertical motion, omitting linear longitudinal and lateral and yaw perturbations. Five analytical models of varying degree of sophistication are applied to a hypothetical hingeless compound helicopter operating up to .8 rotor advance ratio. Stability and response data are obtained for the basic helicopter and for the vehicle with two simple control feedback systems. Author

N74-34488# Advisory Group for Aerospace Research and Development, Paris (France).
TECHNICAL EVALUATION REPORT ON THE AGARD SPECIALISTS MEETING ON DESIGN AGAINST FATIGUE
J. B. DeJong (Natl. Aerospace Lab., Amsterdam) Aug. 1974 16 p
(AGARD-AR-71) Avail: NTIS HC $4.00

Properties and performance data on fighter aircraft fatigue are examined. Damage tolerance associated with structural safety and inspectability is considered, along with flight load monitoring. J.A.M.

N74-34489*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ROTORCRAFT DYNAMICS
Washington 1974 370 p refs Conf. held at Moffett Field Calif., 13-15 Feb. 1974; Sponsored in part by the American Helicopter Soc.
(NASA-SP-352) Avail: NTIS HC $8.00

The dynamic structural analysis of rotary winged aircraft is reported, considering helicopter vibration and loads.

N74-34491* United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
DYNAMIC STALL MODELING AND CORRELATION WITH EXPERIMENTAL DATA ON AIRFOILS AND ROTORS
R. G. Carlson, R. H. Blackwell, G. L. Commerford, and P. H. Mirick (Army Air Mobility R and D Lab., Fort Eustis, Va.) *In* NASA. Ames Res. Center Rotorcraft Dyn. 1974 p 13-23

refs
(Contract DAAJ02-72-C-0105)
CSCL 01B

Two methods for modeling dynamic stall have been developed. The alpha, A, B method generates lift and pitching moments as functions of angle of attack and its first two time derivatives. The coefficients are derived from experimental data for oscillating airfoils. The Time Delay Method generates the coefficients from steady state airfoil characteristics and an associated time delay in stall beyond the steady state stall angle. Correlation with three types of test data shows that the alpha, A, B method is somewhat better for use in predicting helicopter rotor response in forward flight. Correlation with lift and moment hysteresis loops generated for oscillating airfoils was good for both models. Author

N74-34492* Washington Univ., St. Louis, Mo.
COMPUTER EXPERIMENTS ON PERIODIC SYSTEMS IDENTIFICATION USING ROTOR BLADE TRANSIENT FLAPPING-TORSION RESPONSES AT HIGH ADVANCE RATIO
K. H. Hohenemser and D. A. Prelewicz *In* NASA. Ames Res. Center Rotorcraft Dyn. 1974 p 25-34 refs

CSCL 01B

Systems identification methods have recently been applied to rotorcraft to estimate stability derivatives from transient flight control response data. While these applications assumed a linear constant coefficient representation of the rotorcraft, the computer experiments described in this paper used transient responses in flap-bending and torsion of a rotor blade at high advance ratio which is a rapidly time varying periodic system. Author

N74-34493* United Aircraft Corp., East Hartford, Conn. Research Labs.
DYNAMIC ANALYSIS OF MULTI-DEGREE-OF-FREEDOM SYSTEMS USING PHASING MATRICES
Richard L. Bielawa *In* NASA. Ames Res. Center Rotorcraft Dyn. 1974 p 35-43 refs

CSCL 01B

A mathematical technique is presented for improved analysis of a wide class of dynamic and aeroelastic systems characterized by several degrees-of-freedom. The technique enables greater utilization of the usual eigensolution obtained from the system dynamic equations by systematizing the identification of destabilizing and/or stiffening forces. Included, as illustrative examples of the use of the technique, are analyses of a helicopter rotor blade for bending-torsion divergence and flutter and for pitch-lag/flap instability. Author

N74-34494* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
SOME APPROXIMATIONS TO THE FLAPPING STABILITY OF HELICOPTER ROTORS
James C. Biggers *In* Its Rotorcraft Dyn. 1974 p 45-53 refs

CSCL 01B

The flapping equation for a helicopter in forward flight are reported which have coefficients that are periodic in time, and this effect complicates the calculation of stability. A constant coefficient approximation which will allow the use of all the well known methods for analyzing constant coefficient equations are presented. The flapping equation is first transformed into the nonrotating coordinate frame, where some of the periodic coefficients are transformed into constant terms. The constant coefficient approximation is then made by using time averaged coefficients in the nonrotating frame. Stability calculations based on the approximation are compared to results from a theory which correctly includes all of the periodicity. The comparison indicates that the approximation is reasonably accurate at advance ratios up to 0.5. Author

N74-34495* California Univ., Los Angeles. Dept. of Mechanics and Structures.
FLAP-LAG DYNAMICS OF HINGELESS HELICOPTER BLADES AT MODERATE AND HIGH ADVANCE RATIOS
P. Friedman and L. J. Silverthorn *In* NASA. Ames Res. Center Rotorcraft Dyn. 1974 p 55-66 refs

CSCL 01B

Equations for large amplitude coupled flaplag motion of a hingeless elastic helicopter blade in forward flight are derived. Only a torsionally rigid blade exicted by quasi-steady aerodynamic loads is considered. The effects of reversed flow together with some new terms due to forward flight are included. Using Galerkin's method the spatial dependence is eliminated and the equations are linearized about a suitable equilibrium position. The resulting system of equations is solved using multivariable Floquet-Liapunov theory, and the transition matrix at the end of the period is evaluated by two separate methods. Results illustrating the effects of forward flight and various important blade parameters on the stability boundaries are presented. Author

N74-34496* United Aircraft Corp., Stratford, Conn.
CORRELATION OF FINITE-ELEMENT STRUCTURAL DYNAMIC ANALYSIS WITH MEASURED FREE VIBRATION CHARACTERISTICS FOR A FULL-SCALE HELICOPTER FUSELAGE **c32**
Irwin J. Kenigsberg, Michael W. Dean, and Ray Malatino (Naval Air Systems Command) *In* NASA. Ames Res. Center Rotorcraft Dyn. 1974 p 67-80 refs

CSCL 20K

The correlation achieved with each program provides the material for a discussion of modeling techniques developed for general application to finite-element dynamic analyses of helicopter airframes. Included are the selection of static and dynamic degrees of freedom, cockpit structural modeling, and the extent of flexible-frame modeling in the transmission support region and in the vicinity of large cut-outs. The sensitivity of predicted results to these modeling assumptions are discussed. Both the Sikorsky Finite-Element Airframe Vibration analysis Program (FRAN/Vibration Analysis) and the NASA Structural Analysis Program (NASTRAN) have been correlated with data taken in full-scale vibration tests of a modified CH-53A helicopter. Author

N74-34497* Boeing Vertol Co., Philadelphia, Pa.
COUPLED ROTOR/AIRFRAME VIBRATION PREDICTION METHODS
J. A. Staley and J. J. Sciarra *In* NASA. Ames Res. Center Rotorcraft Dyn. 1974 p 81-90 refs

(Contract DAHC04-71-C-0048)
CSCL 01B

The problems of airframe structural dynamic representation and effects of coupled rotor/airframe vibration are discussed. Several finite element computer programs (including NASTRAN) and methods for idealization and computation of airframe natural modes and frequencies and forced response are reviewed. Methods for obtaining a simultaneous rotor and fuselage vibratory response, determining effectiveness of vibration control devices, and energy methods for structural optimization are also discussed. Application of these methods is shown for the vibration prediction of the model 347 helicopter. Author

N74-34503* Boeing Vertol Co., Philadelphia, Pa.
ROTOR AEROELASTIC STABILITY COUPLED WITH HELICOPTER BODY MOTION
Wen-Liu Miao and Helmut B. Huber (Messerschmitt-Boelkov-Blohm G.m.b.H., Ottobrunn, West Germany) *In* NASA. Ames Res. Center Rotorcraft Dyn. 1974 p 137-146 refs

CSCL 01B

A 5.5-foot-diameter, soft-in-plane, hingeless-rotor system was tested on a gimbal which allowed the helicopter rigid-body pitch and roll motions. Coupled rotor/airframe aeroelastic stability boundaries were explored and the modal damping ratios were

measured. The time histories were correlated with analysis with excellent agreement. The effects of forward speed and some rotor design parameters on the coupled rotor/airframe stability were explored both by model and analysis. Some physical insights into the coupled stability phenomenon are suggested. Author

N74-34511* Army Air Mobility Research and Development Lab., Fort Eustis, Va.
EVALUATION OF A STALL-FLUTTER SPRING-DAMPER PUSHROD IN THE ROTATING CONTROL SYSTEM OF A CH-54B HELICOPTER
William E. Nettles, William F. Paul (United Aircraft Corp., Stratford, Conn.), and David O. Adams (United Aircraft Corp., Stratford, Conn.) *In* NASA. Ames Res. Center Rotorcraft Dyn. 1974 p 223-232 refs
CSCL 01B

Results of a design and flight test program conducted to define the effect of rotating pushrod damping on stall-flutter induced control loads are presented. The CH-54B helicopter was chosen as the test aircraft because it exhibited stall induced control loads. Damping was introduced into the CH-54B control system by replacing the standard pushrod with spring-damper assemblies. Design features of the spring-damper are described and the results of a dynamic analysis are shown which define the pushrod stiffness and damping requirements. Flight test measurements taken at 47,000 lb gross weight with and without the damper are presented. The results indicate that the spring-damper pushrods reduced high frequency, stall-induced rotating control loads by almost 50%. Fixed system control loads were reduced by 40%. Handling qualities in stall were unchanged, as expected. Author

N74-34512* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MULTICYCLIC JET-FLAP CONTROL FOR ALLEVIATION OF HELICOPTER BLADE STRESSES AND FUSELAGE VIBRATION
John L. McCloud, III and Marcel Kretz *In* Its Rotorcraft Dyn. 1974 p 233-238 refs
CSCL 01B

Results of wind tunnel tests of a 12 meter-diameter-rotor utilizing multicyclic jet-flap control deflection are presented. Analyses of these results are shown, and experimental transfer functions are determined by which optimal control vectors are developed. These vectors are calculated to eliminate specific harmonic bending stresses, minimize rms levels (a measure of the peak-to-peak stresses), or minimize vertical vibratory loads that would be transmitted to the fuselage. Although the specific results and the ideal control vectors presented are for a specific jet-flap driven rotor, the method employed for the analyses is applicable to similar investigations. A discussion of possible alternative methods of multicyclic control by mechanical flaps or nonpropulsive jet-flaps is presented. Author

N74-34513* Kaman Aircraft Corp., Bloomfield, Conn.
IDENTIFICATION OF STRUCTURAL PARAMETERS FROM HELICOPTER DYNAMIC TEST DATA c32
Nicholas Giansante and William G. Flannelly *In* NASA. Ames Res. Center Rotorcraft Dyn. 1974 p 239-248 refs

CSCL 20K

A method is presented for obtaining the mass, stiffness, and damping parameters of a linear mathematical model, having fewer degrees of freedom than the structure it represents, directly from dynamic response measurements on the actual helicopter without a priori knowledge of the physical characteristics of the fuselage. The only input information required in the formulation is the approximate natural frequency of each mode and mobility data measured proximate to these frequencies with sinusoidal force excitation applied at only one point on the vehicle. The practicality and numerical soundness of the theoretical development was demonstrated through a computer simulation of an experimental program. Author

N74-34514* Boeing Vertol Co., Philadelphia, Pa.
ENGINE/AIRFRAME INTERFACE DYNAMICS EXPERIENCE
C. Fredrickson *In* NASA. Ames Res. Center Rotorcraft Dyn. 1974 p 249-260 refs
CSCL 01B

Problems of engine/drive system torsional stability, engine and output shaft critical speeds, and engine vibration at helicopter rotor order frequencies are discussed, and test data and analyses presented. Also presented is a rotor/drive system dynamics problem not directly related to the engine. Author

N74-34515* Lockheed-California Co., Burbank.
HINGELESS ROTOR THEORY AND EXPERIMENT ON VIBRATION REDUCTION BY PERIODIC VARIATION OF CONVENTIONAL CONTROLS
G. J. Sissingh and R. E. Donham *In* NASA. Ames Res. Center Rotorcraft Dyn. 1974 p 261-277 refs

CSCL 01B

The reduction of the n per rev. pitch-, roll- and vertical vibrations of an n-bladed rotor by n per rev. sinusoidal variations of the collective and cyclic controls is investigated. The numerical results presented refer to a four-bladed, 7.5-foot model and are based on frequency response tests conducted under an Army-sponsored research program. The following subjects are treated: extraction of the rotor transfer functions (.073R hub flapping and model thrust versus servo valve command, amplitude and phase), calculation of servo commands (volts) required to compensate .073R hub flapping (3P and 5P) and model thrust (4P), evaluation of the effect of the vibratory control inputs on blade loads, and theoretical prediction of the root flapbending moments generated by 0 to 5P perturbations of the feathering angle and rotor angle of attack. Five operating conditions are investigated covering advance ratios from approximately 0.2 to 0.85. The feasibility of vibration reduction by periodic variation on conventional controls is evaluated. Author

N74-34517# Rockwell International Corp., Los Angeles, Calif. Aircraft Div.
FIGHTER TECHNOLOGY DEMONSTRATOR PRECURSOR ANALYSIS AND TEST. VOLUME 1: BASELINE DEVELOPMENT AND TECHNOLOGY IDENTIFICATION Final Report, May - Oct. 1973
Nov. 1973 277 p refs
(Contract F33615-73-C-3135; AF Proj. 1207)
(AD-783636; AFFDL-TR-73-112-Vol-1) Avail: NTIS CSCL 01/3

The development of a manned fighter technology demonstrator design, with potential for near-term in-flight evaluation of advanced technologies, is presented. To support the development of this precursor air vehicle, a prime purpose of the study was to establish design goals and criteria against which in-flight technology demonstration could be practically measured. An additional purpose of the study was to assess the usefulness of a selected number of additional technologies for inclusion in the baseline configuration. A final purpose was to conduct a wind tunnel test to provide supportive information of several advanced concepts. Wind tunnel test results showed increased induced life effects with increasing jet flap span and a significant canard contribution to high angle-of-attack directional stability. This latter effect is very important in allowing full use of increased angle-of-attack performance, since it suppresses post all gyration and spin tendencies. (Modified author abstract) GRA

N74-34523# Lockheed-Georgia Co., Marietta.
ADVANCED METALLIC STRUCTURES: CARGO WING DESIGN FOR IMPROVED COST, WEIGHT, AND INTEGRITY Final Technical Report, Jul. 1972 - Jun. 1973
C. R. Brigham, R. E. Barrie, L. M. Atkinson, O. L. Freyre, and H. W. Stemme Jun. 1973 412 p refs
(Contract F33615-72-C-2165; AF Proj. 486U)
(AD-782258; LG73ER0126; AFFDL-TR-73-51) Avail: NTIS CSCL 01/3

With the current Air Force medium transport and tanker fleets rapidly approaching the end of their useful life, a requirement for their replacement is inevitable. Demonstration of innovative advanced structures concepts is required prior to production decisions in order to qualify these advances for new system acceptance. The long lead times required for the development and demonstration of advanced structures dictates that advanced development programs be initiated now to insure the availability of the various technologies when needed for anticipated future systems. This requirement has led to this advanced development program to develop improved aircraft structural designs for a cargo/tanker category aircraft. The C-141 inner wing box was used as the baseline for the preliminary design study phase of this development program. The major objective of this study was to develop advanced designs which would double the fatigue life endurance of the baseline, and which could be produced at lower cost and weight. (Modified author abstract) GRA

N74-34525# Bell Helicopter Co., Fort Worth, Tex.
FLIGHT TEST OF A HINGELESS FLEXBEAM ROTOR SYSTEM Final Report
Charles W. Hughes and Rodney K. Wernicke Jun. 1974 213 p refs
(Contract DAAJ02-72-C-0036; DA Proj. 1F2-63211-D-157)
(AD-783393; BHC-TR-299-099-575; USAAMRDL-TR-74-38) Avail: NTIS CSCL 01/3

This report presents the results of flight tests of a stiff-in-plane flexbeam hingeless four-bladed main rotor, hereafter referred to as the Model 609. The tests were conducted on a modified UH-1 at gross weights from 10,000 to 14,000 pounds and at level-flight speeds up to 150 knots to evaluate performance, handling qualities, maneuverability, and load levels. The tests also evaluated a focused pylon system designed for isolating rotor vibrations. (Modified author abstract) GRA

N74-34526# Army Aviation Systems Command, St. Louis, Mo.
MAJOR ITEM SPECIAL STUDY (MISS). OH-6A TAIL ROTOR TRANSMISSION ASSEMBLY Interim Report, 1 Jan. 1964 - 1 Jul. 1973
Jul. 1974 22 p refs
(AD-782926; USAAVSCOM-TR-74-34) Avail: NTIS CSCL 01/3

The report is designed to illustrate cost savings which would result from specific efforts in the areas of product improvement in quality and design. For the purpose of this study the cost savings produced in the area of product improvement are based on total elimination of a certain failure mode or modes. Appropriate modes are chosen because of their proportion of the total removals or their proportion in combination with other similar modes. These eliminated removals are then assumed to follow the distribution of the remaining removal modes. The actual cost savings are determined from the increase in the mean time to removal based on the new removal distributions. The data used and methods involved are described. GRA

N74-34534# Army Foreign Science and Technology Center, Charlottesville, Va.
REFERENCE MANUAL ON AVIATION MATERIALS
Victor Georgievich Aleksandrov Nov. 1973 196 p Transl. into ENGLISH of the monograph "Spranochnik po Aviagtionnym Materialam" Moscow, 1972 196 p
(AD-783739; FSTC-HT-23-1827-73) Avail: NTIS CSCL 01/3

Operation, servicing and repair of aviation equipment involves the use of various materials, working liquids, compressed gases and other substances. Their correct use makes possible an improved level of technical operation, an increased time period for service and improved reliability of aviation equipment. The book gives the physical, chemical and mechanical properties of steel, nonferrous alloys on a nickel base and on a base of hard-to-melt metals and plastics and ceramic metals which operate in washing liquids, fuel and lubricating materials etc. When using various materials it is necessary to take into account the actual operating conditions, that is, the character of load, temperature, the composition and properties of exterior media, altitude and load capacity of aircraft. Therefore, this handbook presents not only numerical data which characterize the various materials, but also recommendations on technological use and rational utilization during operation, servicing and repair of aviation equipment. GRA

N74-34537# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
ANALYSIS OF PREDICTED AIRCRAFT WAKE VORTEX TRANSPORT AND COMPARISON WITH EXPERIMENT. VOLUME 2: APPENDIXES Final Report, 2 Apr. - 2 Dec. 1973
M. R. Brashears, N. A. Logan, S. J. Robertson, K. R. Shrider, and C. D. Walters Apr. 1974 233 p
(Contract DOT-TSC-593)
(AD-783665; TSC-FAA-74-7-Vol-2; FAA-RD-74-74-II) Avail: NTIS CSCL 01/1

Contents: Summary of aircraft flybys; Probable stability conditions prevalent during selected NAFEC flybys at Atlantic City, N.J.; Description of output plots of wake vortex transport computer program; Description of input requirements for Lockheed wake vortex transport computer program; Summary of line printer output of Lockheed wake vortex transport computer program; Flow charts for Lockheed wake vortex transport computer program; Summary of predicted wake vortex tracks and comparison with experiment; Report of inventions. GRA

N74-34538# Sanders Associates, Inc., Nashua, N.H.
TACTILE DISPLAY FOR AIRCRAFT CONTROL Semiannual Technical Report, 1 Jan. - 30 Jun. 1974
Don H. Rosa, Richard A. Sanneman, William H. Levison (Bolt, Beranek and Newman, Inc., Cambridge, Mass.), and Jeffrey E. Berliner (Bolt, Beranek and Newman, Inc., Cambridge, Mass.) 30 Jun. 1974 94 p refs
(Contract N00014-73-C-0031; ARPA Order 2108; NR Proj. 196-123)
(AD-783690) Avail: NTIS CSCL 01/4

The program was directed towards the development of tactile displays for flight control. The results of the first phase of this program have been reported in the August 73 Final Report (AD-767 763). The report presents a description of an improved tactile display system and its evaluation as a one and two axis error display instrument during a series of manual tracking experiments. Both electrotactors and vibrotactors arrays were used. These experiments were run to obtain modeling data to predict the display performance during the forthcoming F-4 simulator evaluation phase of the program. The tracking error scores for the new tactile display are better than for the initial system. Of the four subjects employed during these tests, two preferred the electrotactor array because it provides a more clearly perceptable haptic display. (Modified author abstract) GRA

N74-34547# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
THE F-89 HYDRAULIC ACTUATOR COMBINATORIAL GEOMETRY REPRESENTATION Final Summary Report, Sep. - Dec. 1973
John Dunn and Gerald Bennett Jun. 1974 39 p refs
(AD-781996; ASD/XR-74-9) Avail: NTIS CSCL 01/3

The report summarizes the generation of a geometric model of an F-89 aileron actuator for a computerized vulnerability analysis using the MAGIC target description computer program. The procedures used and problems encountered are discussed and the resulting target description is presented. GRA

N74-34550# Sperry Rand Corp., Phoenix, Ariz. Sperry Flight Systems Div.
MODIFICATION OF PROTOTYPE FLY-BY-WIRE SYSTEM TO INVESTIGATE FIBER-OPTIC MULTIPLEXED SIGNAL TRANSMISSION TECHNIQUES Final Report
Stephen Osder and David LeFebre Mar. 1974 133 p refs
(Contract F33615-73-C-3108; AF Proj. 1987)
(AD-783269; AFFDL-TR-74-10; Rept-71-0424-00-00) Avail: NTIS CSCL 01/4

A prototype, quad-redundant, fly-by-wire system developed for the Flight Dynamics Laboratory in 1967 was modified to incorporate a fiber-optic data transmission link in one of the four channels. All data flowing between one of the elevator actuator channels and its control computer was transmitted on multiplexed optical data busses in serial-bit, serial-work format at a 500-KHz bit rate. The channel capacity was several hundred times greater than the maximum requirement anticipated for fly-by-wire application. The system was mechanized with a 100-foot, fiber-optic cable and miniature optical transmitter and receiver modules, having a total bandwidth capability of about 4.0 MHz. System performance was verified, and the compatibility of the optical channel and the other three electrical channels was demonstrated. Various fiber-optic cable jacketing configurations were evaluated, and detailed environmental tests were performed on one type of jacketed cable. (Modified author abstract) GRA

N74-34552# Army Aviation Systems Command, St. Louis, Mo.
MAJOR ITEM SPECIAL STUDY (MISS), CH-47A AUXILIARY POWER UNIT (T62-T-2A) Interim Report, 1 Jan. 1964 - 1 Jan. 1973
Jul. 1974 20 p refs
(AD-782927; USAAVSCOM-TR-74-35) Avail: NTIS CSCL 01/3

Major Item Special Study (MISS) reports are performed on DA Form 2410 reportable components. These are time change items and certain condition change items selected because of high cost or need for intensive management. Basically, the MISS reports are concerned with analyzing reported removal data presented in the Major Item Removal Frequency (MIRF) report. The failure modes reported for each removal are examined and grouped into categories which are intended to clarify the intent of the data reporting. From this data, removal distribution can be plotted and an MTR (mean time to removal) can be calculated. The MISS reports then investigate possible cost savings based on total elimination of selected failure modes. These modes are chosen because of the percentage of failure modes. These modes are chosen because of the percentage of failures they represent and/or because they appear to be feasible Product Improvement Program (PIP) areas. Author (GRA)

N74-34654# Boeing Aerospace Co., Seattle, Wash.
COCKPIT SWITCHING STUDY: TEST AND VALIDATION OF A DESIGN PROCEDURE FOR MULTIFUNCTION SWITCHING CONTROLS Annual Technical Report, 1 Feb. 1973 - 31 Jan. 1974
David K. Graham Jul. 1974 237 p refs
(Contract N00014-72-C-0191; NR Proj. 213-088)
(AD-783956; D180-18069-1; JANAIR-740701) Avail: NTIS

The document reports the test and validation of a handbook design procedure, developed during an earlier study, for the step-by-step design of multifunction switching controls (MSC's). An MSC panel for the Navigation and Weapons Delivery System of the A-7E airplane was designed using the procedure, and this panel was then analytically compared with conventional controls on the basis of pilot workload. Variations of the baseline MSC were also designed and tested to ascertain the effect of imposing constraints on the design procedure. The workload comparison was accomplished using a digital computer program developed specifically for workload evaluation. Results show the MSC panels in all respects at least equal, and in most cases superior, to conventional controls on the basis of pilot workload. In addition to the workload advantage, the baseline MSC panel occupied only one-tenth the panel space required for equivalent conventional controls. (Modified author abstract) GRA

N74-34555# Naval Weapons Lab., Dahlgren, Va.
AIRCREW AUTOMATED ESCAPE SYSTEM SIMULATION MODEL
Christopher Gracey Feb. 1974 91 p refs
(AD-783517; NWL-TR-3) Avail: NTIS CSCL 01/3

A math model is presented for simulating the performance of the SEU-3/A Ejection Seat Escape System which employs propulsion, parachute, and stabilization subsystems. Seat/man, man alone, and seat alone configurations are treated as rigid bodies in six degrees-of-freedom. Canopy first recovery parachute deployment by rocket and/or drogue parachute is modelled as well as lines first drouge deployment. Parachute opening equations are treated in detail, and riser/suspension line forces are assumed to be elastic. In addition, an aircraft model is formulated. Author (GRA)

N74-34668 Missouri Univ., Columbia.
ADAPTIVE CONTROL TECHNIQUES WITHOUT PURTURBATION FOR SYSTEMS WITH INACCESSIBLE STATE VARIABLES WITH APPLICATION TO A SUPERSONIC AIRCRAFT AIR INLET CONTROL SYSTEM Ph.D. Thesis
Larry Eugene Williams 1973 277 p
Avail: Univ. Microfilms Order No. 74-18669

Adaptive control techniques, including both input signal and closed loop system adaptation, are presented. Adaptation procedures and associated identification techniques which utilize the normal operating system input and output signals without extraneous system perturbations are emphasized. Also, it is assumed that the system state variables are inaccessible. Most of the control system adaptation and identification techniques appearing in the literature assume that the system state variables are available for measurement or require extraneous system perturbation signals. The application chosen for investigation of the adaptive control techniques is a hypothetical engine air inlet control system for a supersonic aircraft. Dissert. Abstr.

N74-34686# Teledyne Ryan Aeronautical Co., San Diego, Calif.
CATAPULT PERFORMANCE AND INTERFACE REQUIREMENTS FOR LAUNCH OF BQM-34 VEHICLES Final Report
10 Jun. 1974 103 p refs
(Contract F04606-73-A-0048)
(AD-783935; TRA-29369-5) Avail: NTIS CSCL 01/5

The report provides information for the design of a catapult launcher for the Teledyne Ryan BQM-34A and BQM-34F series of drones. Information provides performance and vehicle interface data for an independent contractor to prepare cost estimates for the design and manufacture of a catapult launcher. Curves of engine data are provided for various temperature and pressure conditions. Aerodynamic loads for various pitch attitudes up to 250 KEAS are included. Limit load factor envelopes and limit loads for the present ground launch fittings are presented. Conclusions based on the results of a six-degree-of-freedom dynamic simulation study for a catapult launch of a BQM-34A with the LSI A/A37G-8 autopilot are given. GRA

N74-34715# Hydronautics, Inc., Laurel, Md.
SIMULATION OF WAKE VORTICES DESCENDING IN A STABLY STRATIFIED ATMOSPHERE Final Report, Sep. 1973 - Mar. 1974
Clinton E. Brown and Karl Kirkman Jul. 1974 38 p refs
(Contract DOT-TSC-694)
(AD-783750; FAA-RD-74-116; TSC-FAA-74-13) Avail: NTIS CSCL 01/1

An experimental water tank simulation of aircraft wake vortices descending in a stable atmosphere has indicated that the atmospheric stability stops the downward movement and in some cases produces a subsequent rebound. The tests were carried out in a large ship model basin using a rectangular planform wing. Lift coefficients were selected, and stable atmospheric conditions were obtained by temperature (density) stratification of the towing basin. The model parameters and stability conditions cover the most extreme cases to be expected in full scale flight. GRA

N74-34716# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
ANALYSIS OF PREDICTED AIRCRAFT WAKE VORTEX TRANSPORT AND COMPARISON WITH EXPERIMENT. VOLUME 1: WAKE VORTEX PREDICTIVE SYSTEM STUDY Final Report, Apr. - Dec. 1973

M. R. Brashears, N. A. Logan, S. J. Robertson, K. R. Shrider, and C. D. Walters Apr. 1974 247 p refs
(Contract DOT-TSC-593)
(AD-783649; TSC-FAA-74-7-Vol-1; FAA-RD-74-74-I) Avail: NTIS CSCL 01/1

A unifying wake vortex transport model is developed and applied to a wake vortex predictive system concept. The fundamentals of vortex motion underlying the predictive model are discussed including vortex decay, bursting and instability phenomena. A parametric and sensitivity analysis is presented to establish baseline uncertainties in the algorithm to allow meaningful comparison of predicted and measured vortex tracks. A detailed comparison of predicted vortex tracks with photographic and groundwind vortex data is presented. Excellent agreement between prediction and measurement is shown to exist when sufficient wind data are available. Application of the Pasquill class criteria is shown to be an effective technique to describe the wind profile in the absence of detailed wind data. The effects of wind shear and the Ekman spiral on vortex transport are discussed. It is shown that the combination of wind shear and ground plane may be possible mechanisms underlying vortex tilting and a theoretical explanation is advanced that is somewhat supported by comparison with the experimental data. Finally, recommendations for further vortex data collection in the vicinity of an airport are presented. Author (GRA)

N74-34718# Tennessee Univ. Space Inst., Tullahoma.
AN APPROXIMATE SOLUTION OF UNSTEADY TRANSONIC FLOW PROBLEMS Technical Report, Jun. 1973 - Jan. 1974
J. M. Wu and K. R. Kimble Jun. 1974 38 p refs
(Contract F33615-73-C-3119; AF Proj. 1929)
(AD-783621; AFFDL-TR-74-32) Avail: NTIS CSCL 01/1

Unsteady pressures on a thin two-dimensional airfoil pitching and plunging in transonic flow have been computed by numerically solving the governing partial differential equation. The effect of wing thickness has been retained by using the steady flow potential on the wing in the coefficients of the equation in a manner which generalizes Oswatitsch's parabolic method. The results are compared with other methods and with experimental data.
Author (GRA)

N74-34952# Franklin Inst., Philadelphia, Pa. Research Labs.
CHARACTERIZATION OF CARBURIZED VASCO X-2 STEEL Final Report
L. Leonard and A. Pattnaik Jun. 1974 11 p
(Contract DAAJ01-73-C-0581)
(AD-782362; FIRL-C3678-01) Avail: NTIS CSCL 11/6

The metallurgical characteristics of samples of carburized Vasco X-2 steel (Boeing Materials Specification 7-223) are described. Based upon the expected combination of properties, namely, a high surface hardness for resistance to gear tooth surface deterioration and a softer core for toughness and resistance to crack propagation, this material has been designated for use in the transmission gearing of the heavy lift helicopter. Hardness testing and standard light microscope metallographic analysis was conducted on the case and core. In addition, a transmission electron microscopy study was performed to determine whether an intergranular carbide films were present in the case since such films could seriously impair the mechanical properties. GRA

N74-35194*# Tennessee Univ. Space Inst., Tullahoma.
ON THE INLET VORTEX SYSTEM Final Report
Norbert C. Bissinger and Gerhard W. Braun Sep. 1974 104 p refs
(Grant NGR-43-001-086; NASA-CR-140182) Avail: NTIS HC $8.25 CSCL 21E

The flow field of a jet engine with an inlet vortex, which can pick up heavy debris from the ground and damage the engine, was simulated in a small water tunnel by means of the hydrogen bubble technique. It was found that the known engine inlet vortex is accompained by a vortex system, consisting of two inlet vortices (the ground based and the trailing one), secondary vortices, and ground vortices. Simulation of the ground effect by an inlet image proved that the inlet vortex feeds on free stream vorticity and can exist without the presence of a ground boundary layer. The structural form of the inlet vortex system was explained by a simple potential flow model, which showed the number, location, and the importance of the stagnation points. A retractable horizontal screen or an up-tilt of the engine is suggested as countermeasure against debris ingestion. Author

N74-35201*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF INLET INGESTION OF A WING TIP VORTEX ON TURBOJET STALL MARGIN
Glenn A. Mitchell Sep. 1974 57 p refs
(NASA-TM-X-71610; E-8091) Avail: NTIS HC $3.75 CSCL 21E

A two-dimensional inlet and a turbojet engine were investigated in a Mach 0.4 stream so as to ingest the tip vortex of a forward mounted wing. Results show that ingestion of a wing tip vortex by a turbojet engine can cause a large reduction in engine stall margin. The loss in stall compressor pressure ratio was primarily dependent on vortex location and rotational direction and not on total-pressure variations across the compressor face.
Author

N74-35202*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF A MODEL CASCADE THRUST REVERSER FOR SHORT-HAUL APPLICATIONS
Donald A. Dietrich and Orlando A. Gutierrez 1974 41 p refs Presented at the 10th Propulsion Conf., San Diego, Calif., 21-23 Oct. 1974; sponsored by AIAA and SAE
(NASA-TM-X-71614; E-8119) Avail: NTIS HC $3.25 CSCL 21E

Aerodynamic and acoustic characteristics are presented for a cowlmounted, model cascade thrust reverser suitable for short-haul aircraft. Thrust reverser efficiency and the influence on fan performance were determined from isolated fan-driven models under static and forward velocity conditions. Cascade reverser noise characteristics were determined statically in an isolated pipe-flow test, while aerodynamic installation effects were determined with a wind-tunnel, fan-powered airplane model. Application of test results to short-haul aircraft calculations demonstrated that such a cascade thrust reverser may be able to meet both the performance and noise requirements for short-haul aircraft operation. However, aircraft installation effects can be quite significant. Author

N74-35203*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COLD-FLOW PERFORMANCE OF SEVERAL VARIATIONS OF A RAM-AIR-COOLED PLUG NOZZLE FOR SUPERSONIC-CRUISE AIRCRAFT
Douglas E. Harrington, Stanley M. Nosek, and David M. Straight Washington Oct. 1974 37 p refs
(NASA-TM-X-3110; E-7975) Avail: NTIS HC $3.25 CSCL 20D

Experimental data were obtained with a 21.59 cm (8.5 in.) diameter cold-flow model in a static altitude facility to determine the thrust and pumping characteristics of several variations of a ram-air-cooled plug nozzle. Tests were conducted over a range of nozzle pressure ratios simulating supersonic cruise and takeoff conditions. Primary throat area was also varied to simulate afterburner on and off. Effect of plug size, outer shroud length, primary nozzle geometry, and varying amounts of secondary flow were investigated. At a supersonic cruise pressure ratio of 27, nozzle efficiencies were 99.7 percent for the best configurations. Author

N74-35219*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MEASURED AND CALCULATED NEUTRON SPECTRA AND DOSE EQUIVALENT RATES AT HIGH ALTITUDES: RELEVANCE TO SST OPERATIONS AND SPACE RESEARCH

Trutz Foelsche, Rosalind B. Mendell (New York Univ.), John W. Wilson, and Richard R. Adams Washington Oct. 1974 68 p refs
(NASA-TN-D-7715; L-9389) Avail: NTIS HC $3.75 CSCL 03B

Results of the NASA Langley-New York University high-altitude radiation study are presented. Measurements of the absorbed dose rate and of secondary fast neutrons (1 to 10 MeV energy) during the years 1965 to 1971 are used to determine the maximum radiation exposure from galactic and solar cosmic rays of supersonic transport (SST) and subsonic jet occupants. The maximum dose equivalent rates that the SST crews might recieve turn out to be 13 to 20 percent of the maximum permissible dose rate (MPD) for radiation workers (5 rem/yr). The exposure of passengers encountering an intense giant-energy solar particle event could exceed the MPD for the general population (0.5 rem/yr), but would be within these permissible limits if in such rare cases the transport descends to subsonic altitude; it is in general less than 12 percent of the MPD. By Monte Carlo calculations of the transport and buildup of nucleons in air for incident proton energies E of 0.02 to 10 GeV, the measured neutron spectra were extrapolated to lower and higher energies and for galactic cosmic rays were found to continue with a relatively high intensity to energies greater than 400 MeV, in a wide altitude range. This condition, together with the measured intensity profiles of fast neutrons, revealed that the biologically important fast and energetic neutrons penetrate deep into the atmosphere and contribute approximately 50 percent of the dose equivalant rates at SST and present subsonic jet altitudes. Author

N74-35250*# Kansas Univ. Center for Research, Inc., Lawrence. Space Technology Center.

THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION INTERDISCIPLINARY STUDIES IN SPACE TECHNOLOGY AT THE UNIVERSITY OF KANSAS Final Report

B. G. Barr Sep. 1974 163 p refs
(Grant NGL-17-002-001)
(NASA-CR-140623) Avail: NTIS HC $11.25 CSCL 22A

A broad range of research projects contained in a cooperative space technology program at the University of Kansas are reported as they relate to the following three areas of interdisciplinary interest: (1) remote sensing of earth resources; (2) stability and control of light and general aviation aircraft; and (3) the vibrational response characteristics of aeronautical and space vehicles. Details of specific research efforts are given under their appropriate departments, among which are aerospace engineering, chemical and petroleum engineering, environmental health, water resources, the remote sensing laboratory, and geoscience applications studies. A.A.D.

N74-35362# General Dynamics/Convair, San Diego, Calif. Aerospace Div.

WEAPON SYSTEM COSTING METHODOLOGY FOR AIRCRAFT AIRFRAMES AND BASIC STRUCTURES. VOLUME 1: COST METHODS RESEARCH AND DEVELOPMENT Technical Report, Jul. 1972 - Sep. 1973

R. E. Kenyon and J. M. Youngs Dec. 1973 233 p refs
(Contract F33615-72-C-2083; AF Proj. 1368)
(AD-783639; AFFDL-TR-73-129-Vol-1) Avail: NTIS CSCL 01/3

This report presents the interim results of a study aimed at extending cost estimating techniques developed and demonstrated under a previous contract. The previous study resulted in two separate estimating methods: a trade study and a system costing method. These methods provided two essential estimating capabilities: the capability of assessing the relative difference in the cost of the basic structures attributable to variations in type of construction and material in an iterative fashion to support tradeoff studies during the preliminary design process, and the capability of accurately estimating total airframe costs in manhours and materials for selected design while retaining sensitivity to type of material and construction. (Modified author abstract) GRA

SUBJECT INDEX

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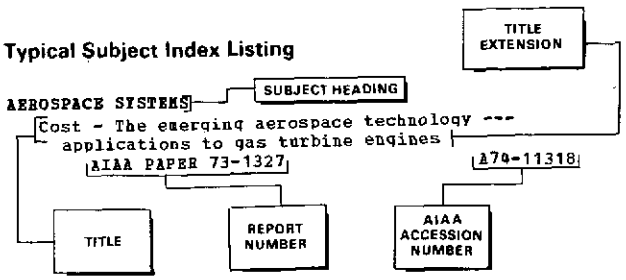

The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of the document content, a title extension is added, separated from the title by three hyphens. The NASA or AIAA accession number is included in each entry to assist the user in locating the abstract in the abstract section of this supplement. If applicable, a report number is also included as an aid in identifying the document.

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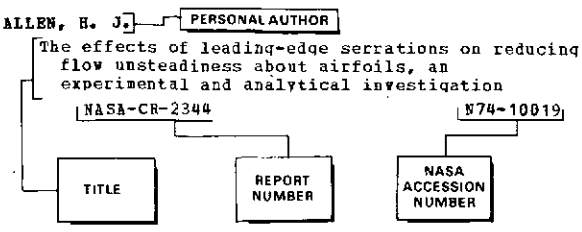

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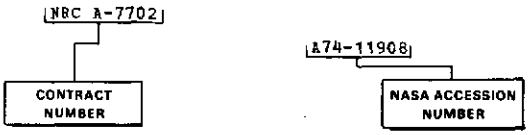

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NASA-Langley, 1975